An investigation of how factors related to teacher quality affect the Grade 12 Physical Science performance in Tshwane District

by

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ABSTRACT

Learners' Physical Science performance in South Africa has been under discussion for several years, the challenge being that it has been exacerbated by continuous changes in the curriculum. Systems that have been put in place have yielded insufficient satisfactory solutions to both underperformance in the subject and sustainable good performance. Although interventions by curriculum policymakers have been ineffective, the issue at hand remains that teachers need to implement good teaching practices in order to ensure that all learners receive quality education. Physical Science teachers are custodians of a subject that may address scarce skills in the education system, so the quality of teaching must be optimised. Teachers need to implement intervention processes put in place by other stakeholders to reduce the negative perceptions that most people have about Physical Science. This study investigates how various factors related to the quality of teachers may affect the performance of Grade 12 learners in this subject. Since past studies have presented a broad spectrum of these factors, this study has categorised them as those directly related to teaching and those indirectly related to teaching. As a basis for data collection the researcher first established the overall status of the Physical Science teachers and investigated how the factors identified affect teaching. A mixed method approach was followed, and given the breadth of the study, available raw data was collected through questionnaires, interviews and observations. Data collected on factors indirectly related to teaching showed that these factors affect factors directly related to teaching and both of them affect the performance of the teacher, and consequently those of learners. These findings revealed that the performance of Physical Science cannot be based on one factor only, but on a combination of factors that are interrelated and should be integrated for effective teaching practices. Recommendations have been made to the National and Provincial Department of Education, District offices, school management teams and Physical Science teachers to reinforce other strategies that have been in place in order to improve or sustain good performance of the subject and to close gaps that have not been identified as possible intervention strategies. They include upgrading qualifications with the current content and methodologies to match the changing curriculum, restructuring workshops so that they are informed by the teacher's needs, stabilising the curriculum to avoid many changes in short periods of time, retraining of teachers, relevant appointment of Heads of Departments (HoDs) into subject management positions, utilisation of support groups by teachers, proper management of the subject, proper screening of Physical Science learners and provision of teaching and learning resources.

KEY WORDS

Physical Science, Teacher quality, Performance, Learners, Professional development

DECLARATION

I Magdeline Mmapaseka Stephen declare that: *An investigation of how factors related to teacher quality affect the Grade 12 Physical Science performances in Tshwane District* is my work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references

_____ 30 November 2013

Magdeline Mmapaseka Stephen Date

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LIST OF ACCRONYMS AND ABBREVIATIONS USED IN THIS STUDY

ACE	Advanced Certificate in Education
ASSAF	Academy of Science of South Africa
BEd	Bachelor of Education
CDE	Centre for Development Enterprise
CEPD	Centre for Education Policy Development
DoE	Department of Education
ELRC	Education Labour Relation Council
FET	Further Education and Training
GDE	Gauteng Department of Education
HEQC	Higher Education Quality Council
HoD	Head of Department
HRMIS	Human Resource Management Information System
HSRC	Human Science Research Council
ICT	Information and Communications Technology
MST	Mathematics, Science and Technology
NBPTS	National Board for Professional Teaching Standards
NGO	Non-Governmental Organisation
NPDE	National Professional Diploma in Education
NPFTED	National Policy Framework for Teachers' Education and Development
NRC	National Research Council
NSTA	National Science Teachers Association
OBE	Outcome Based Education
PCK	Pedagogical Content Knowledge
PGCE	Postgraduate Certificate of Education
REQV	Relative Education Qualification Value
SACE	South African Council for Educators
SASA	South African Schools Act
TIMSS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational Scientific and Cultural Organizations
VSO	Voluntary Services Overseas
WITS EPU	The University of the Witwatersrand Education Policy Unit

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CHAPTER 1

PHYSICAL SCIENCES IN SOUTH AFRICA

1.1 INTRODUCTION AND RATIONALE

Previous research conducted does not applaud the performance of Physical Science in South African schools (Makgato & Mji, 2006; Parker, 2009; Kriek & Grayson, 2009). The results of research, as well as the pass percentage of Physical Science nationally in South Africa are poor. Most literature and speeches by government officials, for example, the minister for education's speech after the 2009 matriculation (matric) final results, and university presentations made at the Academy of Science of South Africa (ASSAF) on "Critical issues in School Mathematics and Science: Pathways to Progress" in 2009, have related the performance of learners to the performance and conduct of teachers. Results of research conducted on teacher quality link the performance of teachers to this factor. Based on literature studied by the researchers on teacher quality, the research categorised factors related to teacher quality as being directly and indirectly related to teaching and they include, amongst others, qualifications, content knowledge, teaching methodologies, attitude, motivation, interest, commitment, professional conduct and behaviour.

Teacher quality cannot be separated from teachers' professionalism, which according to Harber (2005) is the extent to which teachers actually do what is expected of them in their role as teacher and how there are different ideological interpretations of what it means to act professionally, which is a great determinant of teacher quality. Adding to these issues, the South African Council for Educators' (SACE) Code of Conduct for South African Teachers calls on teachers to "…acknowledge that the attitude, dedication, self-discipline, ideals, training and conduct of the teaching profession determine the quality of education" (SACE, 2001:29). Mosoge and Taunyane (2009) explain that the manner of conduct within the practice and how members integrate their knowledge and skills have an influence in their work, which implies that the teaching profession encompasses personal and behavioural determinants such as dedication, commitment and highly skilled practice.

According to Parker (2011), teacher professionalism relates to teachers' work, becoming a professional in outlook, knowledge and commitment, and developing professional judgement. She adds that professionalism addresses how teachers are able to work within the system of professionals. This idea requires that the profession be a quality of the teacher, who can demonstrate an understanding of the knowledge and thinking that underpins his or her actions. The Department of Education (DoE, 2007) in its analysis of teacher professionalism cites that the manner in which teachers behave forms one of the important characteristics of teacher professionalism. Parker (2009) stresses that professionalism goes beyond content knowledge to commitment and disposition, and that the best teachers are passionate about their subjects, inspiring learners to spark interest and commitment within them too. These aspects relate fundamentally to the question of teacher identity, a teacher's consciousness and conscience, and ways of knowing and being. Research tends to agree that quality teaching is greatly influenced by teacher professionalism.

The National Science Teachers Association (NSTA) Position Statement (2007) noted that Physical Science teachers play a central role in educating, inspiring, and guiding learners to become responsible, scientifically literate citizens. Therefore, they must uphold the highest ethical standards of the profession to earn and maintain the respect, trust, and confidence of learners, parents, school leaders, colleagues, and other community members. Quality Science instruction is an interdependent process that requires the active participation and shared responsibility of Physical Science teachers, school leaders, district administrators, school boards, and parents. The NSTA calls on Physical Science teachers to accept a professional responsibility to provide all learners with quality Science education; embrace and promote their professional learning and growth; uphold and strengthen the public image of the profession; and become active leaders and advocates of quality Science education in their schools and communities.

Parker (2009) sees teacher quality as having two facets: i) qualifications, with access to high quality formal (institutionalised) academic and professional learning for the purpose of teaching, both for initial teacher preparation and for career path development; and ii) quality of teaching in the world of work (classroom

/school).The latter is dependent on personal commitment and continued professional learning, as well as teachers' access to powerful forms of knowledge, including a broad and deep understanding of their area of specialisation subject, (learning area, phase) both in and for itself and for teaching. The second facet mostly includes commitment, but consideration has to be given to achieving better quality education across the whole system.

In the McKinsey report of September 2007, two important findings of the study were that the quality of an education system cannot exceed that of its teachers, and the only way to improve the outcomes (learners' performance and the quality that they receive) is to improve instruction. The report found from the experience of top schools that three things were significant in ensuring quality outcomes in education:

- Getting the right people to become teachers.
- Developing teachers into effective instructors.
- Ensuring that the system is able to deliver the best possible instructions to every child.

The available evidence according to the report suggests that the main driver of the variations in learning at schools is the quality of teachers, as the quality of the school system is dependent largely on its teachers. The importance of teacher quality is stressed by King Rice (2003), for whom it is the most important school-related factor influencing learner achievement. Similarly, Townsend Hall (2012) in her contribution to quality teaching writes that the provision of well-qualified and well-trained competent teachers is an essential component of any effective Science education programme.

The United States of Americas' Department of Education annual report on teacher quality (2004) reported that, in general, most teacher quality issues, including preparation, certification, tenure, evaluation, and licensing, continue to be the provenance of states and districts. The first major foray into teacher quality standards came with the passage of the federal "No Child Left Behind Act of 2001", which required every teacher of a core academic subject defined in the law to be "highly qualified." To meet that designation, a teacher had to be certified and

have demonstrated proficiency in his or her subject matter by having majored in the subject in college, passing a subject-knowledge test and obtaining advanced certificate.

Mosoge and Taunyane (2009) indicate that quality education rests on the teacher, who is in daily contact with learners. They added that it is against this background that staff development assumes greater importance in providing quality education to learners. Enhancing the professionalism of teachers rests at the heart of all effort to provide quality education and what the teacher achieves in the classroom has a telling effect on the quality of education in general. However, according to the authors, the subject knowledge of teachers in South Africa is found wanting.

With regard to proficiency in Physical Sciences, the Gauteng Department of Education (GDE) introduced continuing professional development for Physical Science teachers in 2008 in the form of Advanced Certificate in Education (ACE). This qualification targeted teachers with three-year college diplomas, with the aim of improving Physical Science qualifications (National Mathematics, Science and Technology {MST} strategy, 2001). Parker (2009) indicated that with respect to the ACE programmes, there were few taken in subjects taught in schools. In a survey conducted in 2008, of the overall 43,803 registrations across all ACE programmes at 23 Higher education institutions, only 10 programmes offered Physical Science.

Alder (2009) found that few Physical Science teachers had taken advantage of upgrading their qualification in the subject. The majority of those who took ACE courses did not specialise in Physical Science to improve their teaching in the subject, preferring education management and other courses that were not directly linked to Physical Science. Literature has not yet shown if higher education institutions have increased the number of Physical Science programmes with regards to ACE, or if there is an increase in the number of teachers majoring in the subject in ACE programmes.

One of the greatest challenges facing South Africa at present is the provision of high quality education for all its children (Howie, 1999). Makgato and Mji (2006) contend that whilst policies and programmes have been produced on a general scale, very little has happened at a systematic level to address challenges of

providing quality Physical Science teachers. The need to close the scarce skills gaps in South Africa requires an increase in the number of those who are more knowledgeable in the subject to increase the production of higher quality results. Parker (2009) wrote that before reflecting on the use of ACE for upgrading qualifications there is a need to understand who our teachers are, what their qualification and profiles are, and what kind of programme should be supported. She indicated that the data on the specialisation of teachers was not good enough. A data and needs analysis for Physical Science teachers is required to assist subject material designers to design programmes that will address issues affecting their performance in the subject, factors that should address the quality of teachers.

The performance of Physical Science teachers is also attributed to the type of qualifications that they received at tertiary institutions (Parker, 2011). The Trends in International Mathematics and Science Study (TIMSS) reports of 1999 and 2003 supported this by indicating that for many black Physical Science teachers, neither their school education nor their teacher training obliged them to study Physical Science. They were now required to teach a new curriculum and to exhibit a set of competences that the most highly skilled professionals in the developed world would find difficult to demonstrate. Physical Science teaching has traditionally been weak in many schools, as reflected in student teachers' capabilities. There is a shortage of teachers specialising in these subjects, which is a major national concern (Human Science Research Council, 2004). For Jones (2011), some of the teachers in the classrooms are typically older, with teaching qualifications that did not require matric in the past from teacher training colleges.
Besides some teachers of Physical Science having received a college education, the content knowledge of which was not the same as those who received University qualifications, the DoE (2000) policy for programmes leading to qualifications for Grades 10-12 teachers states that content within the discipline underpinning the teaching specialisation must be completed to at least second-year university level. Parker (2009) was concerned that the consistency of teaching qualifications at various tertiary institutions had not yet been verified:

The education system in our country needs to use qualifications to enable career path developments. In other words, to identify and develop excellent Science teachers so that they can become leaders in the system - teaching specialists who are empowered to lead professional developments/ teacher learning communities and mentor and coach other teachers within their localized context, to develop their knowledge and practices for teaching and their identities as Science teachers. The programs must be short, pedagogically sound and content rich for teachers focused on identified areas of need related to what they teach (Parker, 2009: 57).

For teachers to practice in South African schools they should have teaching qualifications and be registered with the South African Council for Educators (SACE). Currently, there is still an insufficient supply of adequately trained Physical Science teachers, Howie (1999) having contended at the turn of the century that approximately 42% of them had only one year training. Research has also reported a lack of Physical Science teaching experience, nearly 40% of Physical Sciences teachers had fewer than two years teaching experience; about 2100 Science teachers leave the teaching profession each year.

The shortage is exacerbated by the number of qualified Physical Science teachers who are in school management positions or teaching a second subject for which they are qualified (Parker, 2009). As a result, unqualified teachers are expected to teach Physical Science, even if they do not have relevant expertise and qualifications. Baloyi (2011) acknowledges that teachers cannot teach what they do not know and understand, but research is sparse on the effect of experience on teacher quality. It is therefore important to establish how, as a contributory factor to teacher quality, and together with qualifications, it contributes to the performance of Physical Science.

The University of the Witwatersrand (Wits) Education Policy Unit (EPU) (2005) states that returns on investment in teacher education, or the quality of performance one might expect from learners in return for money spent on teachers is very low. Despite improvements in their qualifications, many teachers are ill-prepared to teach the grades they are assigned to teach. Many come late to

school, leave early, do not explain or provide feedback on homework and spend too much of their time on administrative tasks.

1.2 BACKGROUND AND ORIENTATION OF THE PROBLEM

The matriculation results of South African learners in Physical Science have suggested for some time the need for improvement (Howie, 1999). The results for the South African learners taking part in TIMSS, although not expected, were received with shock and dismay by the broader community .The TIMSS studies measured Grade 8 learning achievement in Mathematics and Science in several countries in 1995, 1999 and 2003, with South Africa's performance being disappointing in both 1999 and 2003. South African learners attained lower average test scores in both Mathematics and Science than all other participating countries (including other African countries, such as Morocco, Tunisia and Botswana). Out of a maximum score of 800, the average Science score was low: 243 in TIMSS 1999 and 244 in TIMSS 2003 (Human Science Research Council {HSRC} 2004).

After the analysis of the matric results in 2009, for which the overall pass rate was 60.6%, with Physical Sciences 50% nationally, the Minister of Education, Motshekga, acknowledged that there was poor teaching in many schools and a need to offer more support, especially in Physical Science. The minister urged teachers to ensure that teaching and learning was taking place in all schools from the beginning of the school year. She indicated that the senior certificate was an important indicator of the quality of the education system hence this research focus on Grade 12 (Keet, 2010).

The National Policy Framework for Teacher Education and Development (NPFTED) set up in April 2007 provided a framework for strengthening the system to provide high quality initial teacher education in order to ensure a supply of competent, committed and qualified teachers and to support continuing professional development (Parker, 2011). The challenge with teachers to comply with professional standards and become quality Physical Science teachers is that on entering the education system they are not given sufficient support to remain motivated, committed and interested in teaching. Once young teachers graduate

they are placed in schools and expected to be ready to teach immediately. There is no programme for the induction of newly appointed teachers, and only the fortunate find themselves in a school with a Head of Department (HoD) or group of supportive colleagues to induct them into the world of work. Others have to make do with the situation in which they find themselves, and conform to the prevailing ethos of the school (Parker, 2009).

Parker (2009) indicates that in order to improve Physical Science teacher quality, one must consider the supply of future Science teachers, how to attract them into the profession, prepare them, induct them into the world of work and, once there, retain them. There is a need for programmes in the education system that will motivate new and practicing teachers to stay in the profession, to take responsibility for their own professional development and become competent to teach the National Curriculum. In its contribution towards ensuring an improvement in Physical Science, the National MST strategy acknowledges that there are talented teachers who teach Physical Science, some qualified and some not.

In its quest to ensure that every classroom has a competent and qualified teacher, the National MST strategy (2001) strategy aims to upgrade the knowledge, competences and skills of under qualified and unqualified teachers already in the system (DoE,2001). Since Parkers' speech at the ASSAF conference in 2009, a national database and Human Resource Management Information System (HRMIS) that includes a data base for Physical Science teachers has not been made available. This has led to teacher development interventions, such as teacher workshops by Sci-Bono in the Gauteng province, as blanket programmes that might not necessarily address issues that affect the performance in Physical Science.

Another strategy was the implementation of the Dinaledi Schools project (Gauteng MST Improvement strategy, 2009-2014), partly designed to offset historical imbalances in education, but which did not achieve significantly better results (Simkins, 2010). The Centre for Development Enterprise (CDE) report of 2011 by Bernstein, found that in an assessment of 73 Physical Sciences teachers at Dinaledi schools that provided extra help with Mathematics and Physical

Sciences, only 60% of those given problem-solving tests could pass. While their formal qualifications had improved, existing teachers spend too little time in the classroom and many taught badly (Bernstein, 2010).

Kriek and Grayson (2009) indicated that there are multiple, complex problems that contribute to learners' poor performance, including low teacher qualifications. Parker (2009) argued that providing teachers with more qualifications will not necessarily realise the goals of quality teachers, nor are short workshops that do not evaluate teacher learning helpful. She stressed that it is important to move away from qualifications that upgrade teachers mentally to a system that helps them to become more confident and competent in what they teach and to encourage them to take responsibility for their own professional development, rewarding them in the process. South Africa requires competent Physical Science teachers in order to produce the competent Physical Science learners needed to fill the scarce skills gap. Currently, reports of research on the performance of Physical Science calls for a radical change in programmes for new and experienced teachers to address teacher professionalism and teacher quality factors that affect the performance of Physical Science at schools.

1.3 STATEMENT OF PURPOSE

The purpose of this research was to investigate how factors related to teacher quality affect Grade 12 Physical Science performance in Tshwane South District.

In order to achieve the aim, the following objectives were investigated:

- The status of teacher quality in Physical Science teachers in Tshwane South District.
- The extent to which factors related to teacher quality affect the performance of Physical Science results in Tshwane South District in terms of those directly related to classroom teaching and indirectly to the teaching.

1.4 RESEARCH QUESTIONS

The study addressed the following primary question:

- How do factors related to teacher quality affect the Grade 12 Physical Science performance in Tshwane South District?

The following secondary questions assisted in answering the primary question:

- What is the status of teacher quality in Tshwane South Physical Science teachers?
- To what extent do factors related to teacher quality affect the performance of Physical Science in Tshwane South District through the following sub-questions :
    - How do factors that are directly related to teaching affect the performance of Physical Science in Tshwane South District?
    - How do factors that are indirectly related to teaching affect the performance of Physical Science in Tshwane South District?

1.5 SIGNIFICANCE OF THE STUDY

Research has been conducted on various factors that can have an impact on the quality of teaching. Some are directly associated with what the teacher does in the classroom during teaching time, and which directly affect the teaching and learning activities. Others are related to decisions made by the teacher, which he or she is not obliged to carry out but may decide to, in order to enhance teaching practices. The researcher studied the combined impact of both these factors on the performance of Physical Science as a major contributory factor to teacher quality. In the researchers' experience, first as a Physical Science teacher and currently as a Physical Science subject facilitator, she has observed that programmes aimed at improving the quality and performance of Physical Science for both teachers and learners in the Gauteng province have not generally been effective.

Different schools have consistently shown different levels of performance, from good to poor, improved to inconsistent, as well an overall reduction in quality of results. Reports of school visits on curriculum implementation and progress remain the same for some teachers, even after teacher development programmes

over the years. The status quo cannot remain. Sustainable improvement is needed in schools, if possible with Physical Science teachers being empowered in relevant ways that will ensure that they become effective, independent, motivated and interested teachers. Positive results will show in the performance of Physical Science learners.

The findings of the study could be used:

- to provide useful contributions in designing teacher development programmes on teacher quality.
- as a guide or manual for effective classroom practices by teachers that could contribute to increasing performance of Physical Science.
- to contribute to teacher forums on strategies to improve the performance in Physical Science.
- as a guide or manual on what impact effective use of Physical Science teaching resources can have on the performance of Physical Science in schools.

1.6 DEFINITIONS OF CONCEPTS

For the purpose of this study the following definitions will apply in terms selected as key to this study.

Tshwane South district – District consisting of all schools in Mamelodi, Eersterust, Eastlyn, Silverton, Pretoria, Centurion, Olievenhoutbosch, Atteridgeville and Laudium.

Teacher quality – relates to qualifications and the quality of teaching in the world of work (Parker, 2009).

Learner - Any person who is admitted to institutions offering basic education (DoE,1996).

Physical Science – A subject that investigates the physical and chemical phenomena through scientific inquiry, application of scientific models, theories and laws in order to explain and predict events in the physical environment (DoBE, 2011)

Performance – The action or process of performing a task or function (*South African Concise Oxford Dictionary, 2008)*

1.7 INFORMED CONSENT

Before the commencement of the study, permission to participate was obtained from the University, the GDE, school managers as well as teachers required. Application letters to the Gauteng Department of Education, the District Director, school principals and participating teachers are attached as Annexures A-D. Acceptance letter to conduct the study from the Gauteng Department of Education, an example letter from a principal and an acceptance letter from a teacher are attached as Annexures E-G. Letters of permission to conduct the study from the DoE were presented to the school managers, and one from the school management was shown to teachers. Letters of consent were given to all required participants to complete.

All participants were informed of the purpose of the study and allowed to agree or disagree to participate in it. In gaining permission, most researchers give participants assurance of anonymity and describe the intended use of data (McMillan & Schumacher, 2010:334).

The teachers' democratic right to participate or not was respected and those participants who agreed to take part were informed of their right to withdraw from the research at any time, without repercussions. As it was voluntary, any participant who wished to withdraw was not followed up but replaced.

1.8 LIMITATIONS OF THE STUDY

Limitations of the study could not be overlooked since participation was not compulsory and those who did not want to participate might have been the ones who could have provided crucial information.

1.9 CHAPTER OUTLINE

This study comprises five chapters, outlined as follows.

Chapter 1

This chapter has presented an introduction and rationale of the study, background orientation of the problem, purpose of the study and research aims and design.It further explained the theoretical framework that governed it.

Chapter 2

This chapter reviews the literature on factors relating to teacher quality which affect the performance of Physical Science researched in South Africa and in other countries.

Chapter 3

This chapter presented research design and methodologies, area of the study, population, sampling methods, data collection procedures, data collection instruments as well as their justification in the research. Ethical considerations and limitations of the study were also presented.

Chapter 4

In this chapter, collected data was analysed and presented by simplifying raw data, and drawing conclusions.

Chapter 5

This chapter presented a summary of all major findings of factors related to teacher quality and their contributions to the performance of Physical Science. They were categorised as factors, directly related to teaching and those that were indirectly related to it. Recommendations, implications for further studies and conclusion were then drawn.

1.10 CONCLUSION

Chapter one provided an overview and outline of development of the study. The next chapter is a literature review of studies previously conducted, predominantly from in South Africa but also international research on similar issues.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review, if conducted carefully and presented well, adds much to an understanding of the research problem and helps place the results of the study in a historical perspective. It is a summary and analysis of the relevant literature about the research problem, and illuminates the related literature to enable the reader to gain further insight from the study. Literature includes many types of sources: professional journals, scholarly books and monographs, government documents, dissertations and electronic resources (McMillan & Schumacher, 2010:75).

This chapter provides an account of literature reviewed on how factors related to teacher quality affect the performance of Physical Science in South African schools and other schools internationally. Literature was mainly reviewed from primary sources such as journals, articles, education policy documents, speeches by government officials and Physical Science specialists, newspapers and books, both internationally written and in South Africa. Some researchers have attributed teacher quality to direct classroom activities, which include qualifications and some set of standards such as accreditation, knowledge and skills. Others relate them to teacher professionalism, which is mainly related to behaviour and conduct, or to both classroom practice and professional conduct. For example, Adendorff, Mason, Modiba, Faragher and Kunene (2001) and Day (2004) cite that the concept of professionalism in teaching is understood through the level of education. Campbell, Phillips and Gilroy (2004) regarded teacher professionalism as referring to the knowledge, skills and procedures employed by teachers in the process of teaching, whilst for the DoE (1996) it incorporates values, ethical commitment, knowledge and skills required for professional practice. According to the Gauteng MST strategy (2009-2014), professionalism is a balance between a set of professional instructional skills, mastery of content knowledge and a set of positive attitudes in the teacher.

Since teaching and the quality thereof depends on the combination of many factors, the researcher chose to study factors affecting teacher quality in the classroom and those indirectly related to teaching. Factors which are directly related to classroom teaching refer to what and how teachers teach. For the purpose of this study, and according to previous research, they are teachers' qualifications, continuing professional development, knowledge, competence and experience.

Factors that are indirectly related to teaching are taken as those that depend on the teachers' decision to enhance their quality of teaching and are related to teacher professionalism. For the purpose of this study, and according to previous research, these are professional values, professional conduct/ethics, and teachers' behaviour, attitudes, motivation, interest and commitment.

Both of these sets of factors will be collectively used as key to affecting teacher quality in Physical Science, and to provide an in-depth insight into teacher performance, especially in Physical Science, with the hope of shedding light into solutions of challenges encountered.

2.2 TEACHER QUALITY

It is widely recognised that teachers play a central role in determining the quality of education received by learners (United Nations Educational Scientific and Cultural Organization {UNESCO}, 2006). They are understood by the Voluntary Services Overseas (VSO, 2002:4) to be the "central actors in education, facilitators of learning, bringers of knowledge, brokers of relationships between pupils and the societies in which they live", whilst for King Rice (2003) quality is the most important school-related factor influencing learner achievement. Within developing societies specifically, teachers are often seen as the major learning resource because working and living conditions are difficult, teaching resources scarce and teachers considered the only way in which society is able to achieve its educational aspirations: "Teachers' interaction with learners is the axis on which educational quality turns" (VSO, 2002:10).

Van der Berg and Burger (2010) argue that teachers play a pivotal role in the quality of education received by learners. Delegates at the Commonwealth

Conference (2011) indicated that teacher quality is very unevenly distributed, with some teachers proving to be outstanding and performing beyond the expectations of both the education system and the community at large, whilst others fail to prepare for class, do not comply with rules, or are generally incompetent. The quality of improving teacher quality shows a promise for increasing teacher retention. Identifying the effective interventions and understanding how and why they work, is critical. Possible interventions include comprehensive induction programmes, improved professional development, opportunities for classroom teacher advancement, and learning teams (Long, 2007).

Teacher quality itself depends on a number of factors, including the individuals attracted to the teaching profession, their incentive to perform well as teachers, and whether high ability teachers remain in the teaching profession (Harnani-Limarino, 2005). The National Policy Framework for Teacher Education and Development (NPFTED), set up in April 2007 in South Africa, provides a framework for strengthening the system to provide high quality initial teacher education to ensure a supply of competent, committed and qualified teachers and to support teachers through continuing professional development. The slogan '*More Teachers, Better Teachers*' reflects a position that South Africa cannot take in more teachers and sacrifice quality. As Parker explained, working towards this vision requires a two-pronged approach in which, firstly, there must be a teacher recruitment campaign to attract good young entrants to the profession, and secondly, the image of the profession needs to be improved, which also includes addressing the reality of the classrooms (Parker, 2011).

In a study conducted on the quality of Physical Sciences teachers in KwaZulu-Natal, Muwanga-Zake (2006) indicted a dearth of learners' participation and ideas, with lessons, even practical ones, often educator-centred. This indication of poor teaching has been topical for a long time, as the standard of the Physical Science teachers has become questionable. From research by Kriek and Grayson (2009), it was concluded that schools are only as good as their teachers, regardless of how high their standards and technology, and how innovative their programmes.

Long-term sustainable improvements in Science education must therefore focus on strengthening teachers. Desirable teacher qualities are reportedly linked to

good subject knowledge, teaching skills and classroom management, relationship with learners, dedication, accessibility and hard work.

2.2.1 Factors directly related to teaching

Teacher quality is probably the most important school-based factor affecting achievement (Sawchuk, 2011); nevertheless, the specific characteristics that constitute an effective teacher are hotly debated, in large part because teacher quality is extremely difficult to measure. As a result, most studies resort to measurable proxies, such as certification, academic degrees, and years of experience (Rivkin, Hanusheck & Kain 2005). Internationally, and particularly across the Commonwealth, delegates indicated at the 2011 commonwealth conference that there has been a devaluation of the professional status of teachers.

According to Shon (2006), teachers are substantially different from the expert professionals in professional training, induction process into the field, professional autonomy, practitioner-client relationship and social status. These differences not only characterise the nature of teaching but also of the education that learners receive at schools. The University of the Witwatersrand (Wits) Education Policy Unit (EPU) (2005) reports that the image of the teaching profession, the number and quality of entrants to the profession, the quality of their initial and continuing education and training, their motivation, conditions of work and career prospects, are important if the aspirations for curricular, pedagogic and assessment reform in South Africa are to be realised.

Quality education will show if teachers teach what they are qualified to teach. Parker (2011) argues that teachers may be qualified but they are teaching something they are not qualified to teach. Currently, once a teacher is qualified to teach he or she is taken into the system and can be used when necessary in a school, not necessarily in the specialisation for which they were educated. A teacher's qualification is not always taken into account in their utilisation. The focus on upgrading programmes (particularly with the ACE) that is currently weighing down the higher education system will not necessarily bring with it better results, even if it is more focused on subject content than on more generic

knowledge. At the same time, short workshops that do not evaluate teacher learning are not helpful.

It is important that the country move away from a mentality of qualification upgrading to a system that helps teachers to become more confident and competent in what they teach. There is a need to encourage teachers to take responsibility for their own professional development and reward them for doing so (Parker, 2009). Parker also raised a concern that in order to improve Physical Science teacher quality one must consider the supply, how they are attracted into the profession, preparation, induction into the world of work, and retention once there. At present this is problematic.

The following factors were investigated as those that are directly related to classroom teaching as determinants of teacher quality.

2.2.1.1 Teacher qualifications

The South African Council for Educators (SACE) (2000) was established as a statutory body for registration of all teachers. Initial teaching qualifications were raised to M+4, by the Relative Education Qualification Value (REQV 14), making teaching a postgraduate profession, and entry qualifications became the four-year Bachelor of Education (BEd.) or the one-year Higher Diploma in Education, also known as the Postgraduate Certificate of Education (PGCE). Vallicelli (2012) stressed the importance of qualifications by indicating that: “Decision making by well-trained professionals allows individual clients’ needs to be met more precisely and promotes continual refinement and improvement in overall practice”. He added that a professional is trained to handle all situations, as most episodes in the classroom require quick thinking.

An Educational Testing Service study, *How Teaching Matters*, which was presented in the teacher professionalism model (2003), found that learners achievement increase when they have teachers who are trained in developing higher-order thinking skills, who know how to implement hands-on experiences in the classroom and who are trained to work with special populations, which provides them with a greater repertoire of strategies and increases their focus on an individual learner’s needs. Research suggests that the selectivity and/or

prestige of the institution a teacher attended, has a positive effect on learner achievement, particularly at the secondary level. This may partially be a reflection of the cognitive ability of the teacher (King Rice, 2003).

Research indicates that learners in schools with a high percentage of qualified teachers outperform those in schools with significantly fewer (Teacher Professional Model, 2003). Parker (2011) concedes that one cannot look at two graduates from different universities and see the same person, as was reflected in the Higher Education Quality Council (HEQC) review. However, the review enables sharing across the system and understanding of it as a whole. She added that the moderation of qualifications and assessment of teachers should also be addressed. Currently, in South Africa, all of the high-end universities moderate each other's work and the low-end universities all moderate it.

It has been reported that out-dated teaching practices and lack of basic content knowledge have resulted in poor teaching standards, exacerbated by a large number of under-qualified or unqualified teachers who teach in overcrowded and non-equipped classrooms (Makgato & Mji, 2006). The combination of these factors has in turn produced a new generation of teachers who are perpetuating the cycle of mediocrity (DoE, 2001). The National Teacher Education Audit of 1996, followed by the Mathematics and Science Audit of 1997, produced factual and statistical revelations about teachers and teaching in these areas. Whilst policies and programmes have been produced on a general scale, very little has happened at a systemic level to address the challenges of providing quality Physical Science teachers. More than 68% of Physical Science teachers have had no formal subject training (DoE, 2001). The problem of inadequate training was particularly identified in the general education phase of the schooling system (Douglas, 2005).

South African teachers who qualified through teacher training colleges learned to teach in a particular prescribed way, and their content knowledge was often not extended beyond the standards expected from learners. In many schools, especially those for black learners, many teachers were trained to the level of M+2 (REQV 12) or M+3 (REQV 13) and unqualified and even un-matriculated teachers were common. Poor and uncritical training encouraged teachers to teach as they

themselves were taught, often resulting in a mechanical and uncreative process (Douglas, 2005). According to Jones et al. (2006), other teachers experience difficulty in the profession because their training has not equipped them with a repertoire of skills to use in the classroom, or because they have developed unhelpful practices that have gone unchecked. Parker (2011) added that with respect to teacher qualification the legacy of apartheid remains in South Africa and needs to be addressed rather than ignored.

At the 2011 Commonwealth Conference, Parker indicated that 89% of teachers in South Africa had professional teaching qualifications, but there is a variety. Only 18 per cent of practising teachers were graduates when they started out and came through a degree programme rather than a college diploma programme. Currently, 24,349 teachers (6.3%) have a qualification below what is currently counted as the professional level for teachers (i.e., below REQV 13, or a three-year qualification). There are also 20,000 teachers (5.1%) who have the three-year top qualification but who are unqualified professionally. For example, they have a degree but not a postgraduate certificate. Any teacher who is not at the level of REQV 10, equivalent to a matriculation, was at some stage considered a qualified teacher (either with a certificate or diploma), but is now no longer considered qualified. The employment of unqualified teachers in the system continues to be a problematic issue in South Africa.

The performance of Physical Science teachers is attributed to the type of qualifications that teachers received at tertiary institutions (Parker, 2011). Evidence suggests that teachers with advanced degrees have a positive impact on high school Physical Science achievement when the degrees earned are in this subject. Thus, standards in the Physical Science classrooms may fall because of the shortage of properly trained Science teachers. Jones (2011) also added that some of the teachers in the classrooms are typically older teachers with teaching qualifications that did not require matric in the past from teacher training colleges. He adds that what perpetuates the problem, especially in key subjects such as Physical Science, is that existing teachers are not teaching well and are poorly managed. This is partly because many of them have been poorly trained.

Currently, there is an insufficient supply of adequately trained Science teachers. The Department of Education National MST report of 2001 published by Edusource in 1997 found that with 84% of Science teachers professionally qualified, only 42% were qualified in Physical Sciences. An estimated 8,200 Science teachers therefore needed in-service training to address their shortcomings in these subjects. Attracting and retaining sufficient numbers of Physical Science graduates in the teaching profession is a serious problem confronting many countries around the world, where these graduates are in demand and are better paid in the private sector and in other occupations. South Africa is no exception when it comes to the problem of under-supply of competent, qualified Physical Science teachers.

Many studies suggest that more qualified and experienced Physical Science teachers are associated with higher levels of learner achievement in these fields of learning (DoE, 2001). Hamlyn (2010) indicated on behalf of the Democratic Alliance parliamentary question in 2010, after 2009 Physical Science matric results, that 1,700 South African Science teachers are not qualified to teach the subject. According to the party, that meant that 5,000 learners are not receiving teaching from qualified teachers. The 2009 matriculation had an extraordinary 60% of all scholars who wrote Physical Science receiving a mark of less than 40%.

In South Africa, there is no post-provisioning system that is connected to the curriculum, which is problematic and has important implications for the professional development of practising teachers. This also points to the need for an understanding of the system and for teachers to understand the qualification profile, not a uniform stricture for the variety of different teachers and their needs. After the inception of Curriculum 2005 which placed more emphasis on outcome based education, there was a serious concern among teachers that the under-qualified or unqualified teachers would not be able to implement it. The provision of well-qualified and well-trained, competent teachers was the most important component of any effective Science education programme.

2.2.1.2 Teachers' professional development

According to Steyn (2004), professional development relates to lifelong development programmes that focus on a wide range of teachers' knowledge, skills, and attitudes in order for them to educate learners more effectively. They include formal and informal activities carried out by individuals or organisations to enhance staff growth. Guskey (2002) adds that professional development activities are frequently designed to initiate change in teachers' attitudes, beliefs and perceptions. (Lessing & De Witt, 2007), and that these programmes should afford teachers an opportunity to apply their newly acquired knowledge in practice towards in-service education if intended to support and assist the professional development that teachers ought to experience through their working lives.

Professional development is not undertaken for its own sake but with some purpose in mind. It may, for example, be linked to the introduction of a new curriculum or policy, or it may be designed to promote change or improvement within the current curricular framework (Rogan & Aldous, 2004). Increases in the number of unprofessionally trained teachers may well account for the urgent need of quality teacher professional development, which according to Day and Sachs (2004) is also likely to affect the attitudes and approaches and may contribute to the quality of learning and teaching process. Kent (2012) argues that for professional growth, teachers must stay current in best teaching practices and overall improvement in programme quality. Professional development sparks curiosity, motivation and new ways of thinking.

Professional development, one of the major focuses of government policy (Campbell, Phillips and Gilroy, 2004), is necessary because teaching today takes place in a world of rapid change and hence teachers are expected to meet high standards of teaching and raise levels of achievement in schools. Good professional development respects the professional stature and needs of teachers and is targeted at the things teachers need to know and be able to do in order to be successful in the classroom. Quality professional development is indisputably central to building, improving and sustaining the quality of teacher professionals. For them to continue functioning efficiently and productively and contribute meaningfully towards quality education, they must be given training opportunities

to keep them up to date and hence be able to face new professional, academic, and global society challenges. In this regard, quality teacher professional development programmes are meant to empower teachers in line with changes taking place in the world.

Quality teachers in schools, colleges or universities are products of quality teacher education and re-education programmes. In this respect, developing quality teacher professionals is about empowering them in affective, cognitive and psychomotor domains. Developing quality teacher professionals and building their capacity is instrumental in the development not only of education but also of society. In sum, the concept of quality teacher professional development is therefore about the process that entails empowering teachers with the potential or professional qualities to undertake, on a regular basis, the teaching enterprise. It is a course of action destined to make teachers professionally alive, whether cognitively, affectively or pedagogically (Anangyise, 2012).

In order to address the imbalance in teacher qualifications, knowledge can be supplemented through continuous professional development. A number of initiatives and programmes have been developed at national and provincial level, including the upgrading of qualifications though ACE, National Professional Diploma in Education (NPDE), and continuing teacher development workshops in challenging subjects such as Physical Sciences. In addition to upgrading qualifications and workshops, the researcher saw a need to explore the need for induction programmes for new teachers as a means to enhance quality performance in Physical Sciences.

2.2.1.2.1 *Upgrading qualifications*

Currently there is a focus on upgrading the qualifications of existing teachers through formal qualification programmes. There are two such qualifications used: the National Professional Diploma in Education (NPDE), which targets under-qualified primary teachers with old apartheid era (one or two years) teaching certificates, and the Advanced Certificate in Education (ACE), which targets teachers with three-year college diplomas (Parker, 2009). With respect to the ACE programmes, there are very few that are taken in subjects taught in schools. In

2000, SACE started working collaboratively with the Education Labour Relations Council (ELRC) to upgrade teacher qualifications through the National Professional Diploma in Education (NPDE), an interim inset qualification for the 22% of teachers who did not hold the required formal M+3 (REQV 13) qualification.

The knowledge base that underpins better qualifications and professional status was an obvious focus for transformation and redress in post-apartheid South Africa, and many teachers were able to upgrade their qualifications through the SACE and ELRC initiative (Narsee, 2002). Between 1999 and 2002, unqualified and under-qualified teachers were reduced from 25% to 16% of the teacher body. The slight improvement in the ratio for higher ranked staff signifies improved professional support for teachers within schools (Bot, 2003). Advanced certification provides formal recognition and rewards excellence in teaching, including pay incentives and increased responsibility that can lead to an advanced tier of teaching professionalism (Teacher Professional Model, 2003).

In South Africa, specifically in Gauteng province, the government tried to eradicate the problem of under-qualification, especially in key subjects such as Physical Science, through teacher development programmes and offering bursaries for teachers who wished to upgrade their qualifications for the ACE programme (DoE, 2001). Parker (2011) argues that adding new qualifications to the system is not necessary to improve professionalism. We need to take seriously initial teacher qualifications and training programmes. She adds that professional development opportunities were, and still are, few and costly for teachers, and do not necessarily reward or support a career path for them.

The move to Outcomes Based Education (OBE) was the most significant change experienced by teachers. The knowledge base of South African teachers improved during the period of research in that a significant number of teachers upgraded their qualifications through further study (Lessing & De Witt, 2007). Notwithstanding the improved qualifications of the teaching force the majority of teachers are not yet sufficiently equipped to meet the needs of a 21st Century environment and their poor conceptual and content knowledge is a direct contributor to low levels of learner achievement (DoE, 2001).

2.2.1.2.2 *Continuing teacher development workshops and continuous professional development*

Continuous professional development refers to any activity aimed at enhancing the knowledge and skills of teachers by means of orientation, training and support (Coetzer, 2001). According to Bredenson (2003), to allow professional teacher development to proceed successfully it should be a continuous process contributing to the general improvement of education. It is most effective when it is a continuing process, which includes appropriate, well thought out training and individual follow up. Continuing professional development allows teachers to expand and deepen their teaching (Teacher Professional Model, 2003).

A study by the University of the Witwatersrand (Wits) Education Policy Unit (EPU) (2005) revealed that South African teachers were inducted into the new system using a cascade model of training, which proved problematic as the complexity of the curriculum was watered down with each level of training. Since 1994, major changes have occurred in the education policy of South Africa which contrary to expectations, have not always been welcome (Lessing & De Witt, 2007). Teachers have been challenged to move to an outcome based educational approach in a short period of time (Department of Education, 2001). Douglas (2005) presented a report from the Education 2000 Plus, a report that was compiled by the Centre for Education Policy Development (CEPD) and its partners in 1997 which sought to track and examine the transformation of the schooling system in South Africa focusing on policies and programmes of the new government. The report stated that between 1998 and 2002 teachers were mainly being kept abreast of policy, with most training conducted through workshops or seminars, often by cascading, a technique found by recipients to be insubstantial and unsatisfactory. Some Non-Governmental Organisations (NGOs) provided teacher and management support and development, but again this tended to consist of workshops. In-service OBE training and training support materials were described as inadequate and minimal considering that teachers were expected to implement a new methodology and curriculum.

Guskey (2002) cites that high quality professional development is a central component in nearly every modern proposal or improving education. Policymakers

increasingly recognise that schools can be no better than the teachers and administrators who work within them. They are aimed at improving learning. Professional development programmes are systematic efforts to bring about change in the classroom practices for teachers, in their attitudes and beliefs and in the learning outcomes of learners. What attracts teachers to professional development therefore is their belief that it will expand their knowledge and skills, contribute to their growth and enhance their effectiveness with learners. Developments programmes that fail to address these needs are unlikely to succeed.

Lessing and De Witt (2007) argue that courses should be designed to provide avenues for teachers to refresh their knowledge, to improve their competencies and to bring about a paradigm shift in their outlook towards educational issues. The basic principles which have guided the design of in-service courses are that a teacher needs to have subject knowledge. A teacher with a sound foundation in his/her subject matter will be better able to plan for learning based on content outcomes and to keep abreast of current developments in that specific field of knowledge.

To uphold the highest professional standards, the NSTA (2007) recommends that Science teachers promote their own personal professional development and recognise that becoming an effective Science teacher is a continuous process that requires a commitment to lifelong learning, staying current on literature in Science and pedagogy and striving to be reflective practitioners who generate new knowledge and share it with others. In addition, they should seek out formal and informal opportunities to learn, such as becoming active in professional associations; organising and attending conferences; taking courses and seminars; reading professional publications; visiting other classrooms; and interacting with colleagues, mentors, and coaches to support their personal growth.

2.2.1.2.3 *Induction and development for new teachers*

Acknowledging induction as a phase of teacher preparation demonstrates a formal recognition on the part of policymakers that all beginning teachers need support and that teacher preparation must be connected to practice. This model calls for

every first-year teacher to have an experienced and available mentor. Consequently, professional growth of mentored teachers outpaces that of non-mentored teachers. Research also shows that the former use a wider variety of teaching practices than the latter. Effective mentoring leads to beginning teachers' increased satisfaction and competence in teaching, better classroom management techniques and use of a wider range of materials. Pre-service teacher preparation programmes would be more effective and respected if they represented the knowledge, dispositions and skills that teachers must possess to increase learner achievement (Teacher Professional Model, 2003).

2.2.1.3 Teachers' knowledge

Villegas-Reimers (2003) links professional standing of teachers to the knowledge base required to fulfil their role, which encompasses content knowledge as well as pedagogical knowhow. It is generally accepted today that content knowledge alone is insufficient for effective teaching, but over-emphasis on technique and classroom management at the expense of content can equally impoverish teaching. Teachers require balanced training in content and teaching methods. If South Africa is going to compete effectively in world markets, a well-educated corps of people with knowledge and skills at all levels in Physical Science will be needed.

For teachers to impart effective knowledge to Physical Science learners they themselves need to possess efficient content knowledge and skills in the subject. Content knowledge needs to be coupled with pedagogical knowledge to achieve desired outcomes. The teacher professional model (2003) presented a report by the National Research Council (NRC) paper of 1999 which indicated that teachers must be very skilled in working with learners to develop true understanding of concepts. The report concluded that the level of skills that a teacher must have to ensure student understanding takes time to develop, and that content knowledge alone is not sufficient for a teacher. Pedagogical coursework seems to contribute to teacher effectiveness at all grade levels, particularly when coupled with content knowledge (King Rice, 2003).

Makgato and Mji (2006) argue that content knowledge alone has little significance in the classroom if it is not coupled with good teaching methodologies. Programmes for teacher development as well as formal tertiary programmes for Physical Science should strengthen subject matter mastery (content and skills) as well as pedagogical content knowledge (PCK), which refers to how to teach specific scientific concept and principles to young people at different stages of development or ways of representing the subject to make it comprehensible to others. Mastery of content knowledge and good classroom practices can enhance the confidence of teachers and improve their performance in Physical Science as well as those of learners. It is therefore imperative that as well as content knowledge required for teaching Physical Science, teachers must also have sufficient pedagogical content knowledge for teaching. Parker (2011) indicates that teachers also need support to create the right types of training programmes that are pedagogically deep and content rich.

The United States of Americas' Department of Educations' annual report on teacher quality published in the education week of the 04/08/2004 concedes to this by indicating that deep content-area knowledge is also an attribute of teachers that seems to have a positive impact on learner achievement.

Teaching Physical Science at school requires more input than other subjects, because the teacher has to prepare for practical work and to care for the equipment and the laboratory, yet Physical Science teachers have the same number of periods and classes as teachers for other subjects. Similarly, other factors, such as overcrowding, create more work for a Physical Science teacher than for example a Mathematics teacher. Such relatively high loads due to Physical Science teaching prevail in many schools and could make it unpopular (Muwanga-Zake, 2006).

2.2.1.3.1 *Teachers' content knowledge*

Professionals are expected to have the necessary expertise to do their work. The status of a profession has in part been a reflection of its identification with a distinctive body of knowledge, as the basis for decisions that are made with respect to the unique needs of clients. The professional autonomy and

authoritative power of the professionals over their practices is also derived from this expertise of the professionals. A teacher needs to have content knowledge, a sound foundation in subject matter making him or her better able to plan for learners based on content outcomes and to keep abreast of current developments in that specific field of knowledge (Shon, 2006).

In research conducted as part of the president's Education Initiative Research Project, Vinjevold (1996:139) states that:

> Teachers' poor grasp of the knowledge structure of Physical Science acts as a major inhibition to teaching and learning this subject. Strengthening content knowledge should therefore be an essential component of any professional development. It has been reported that lack of basic content knowledge have resulted in poor teaching standards.

If teachers are confident in possession of content knowledge of the subject they teach, have a grasp of common misconceptions learners present in the classroom, and possess strategies for inducing learners' conceptual change through PCK, it becomes easy for them to motivate learners in the subject (Makgato & Mji, 2006).

Along with preparation, a professional teacher with a strong knowledge has enough time to teach material rather than spending significant amounts of time studying it. With the advantage of knowing one's curriculum material well, the teacher has more confidence in his or her teaching, having already placed significant thought on the material being taught. Thus, a professional is able to dwell on how to relate subject matter to the learners and their cultures in an original method (Vallicelli, 2012).

The National Board for Professional Teaching Standards (NBPTS) write that teachers should know the subjects they teach and how to teach them to learners by demonstrating the following skills:

- understand how their subject is related to other disciplines;
- develop learners' critical and analytical thinking skills;
- understand the preconceptions learners have about a subject area;
- use multiple strategies to convey a concept;

- teach learners how to pose and solve their own problems (Education Policy and Leadership Centre, 2002).

2.2.1.3.2 *Teachers' pedagogical content knowledge*

Pedagogy contributes to positive education outcomes (King Rice, 2003), and according to Vallicelli (2012) it affects the student's ability to learn effectively. It can be defined as the ability to reach learners in an effective way, developing innovative approaches to mandated content while motivating, engaging, and inspiring young adult minds to prepare for ever-advancing technology. A professional teacher educates so that learners understand concepts and apply them to their lives. A teacher who has a defined pedagogy has already journeyed through several trials to discover which pedagogical techniques are most effective. Although this may take years to fine-tune, a professional is willing to self-evaluate his or her pedagogy as she/he develops it, revising when deemed necessary, and applying personal ideas to a practical situation (Vallicelli, 2012).

Pedagogical skills, such as techniques, methods, material and overall management, are essential to every teacher, who has a practical theory that is knowledge directly related to actions in and experience of the classroom. Practical theory of teachers refers to private, integrated but ever-changing systems of knowledge, experience and values that are relevant to teaching practice at any particular time. Pedagogical coursework will contribute to teacher effectiveness at all grade levels, particularly when coupled with content knowledge (King Rice, 2003).

Even though government and other NGOs' are offering teacher development programmes, teacher-dominated approaches and rote learning is still a norm (Gaigher, Rogan & Braun, 2006). Makgato and Mji (2006) argue that effective teaching involves incorporating PCK and teaching strategies for addressing them. It has been found that learners admired good personal qualities and teaching techniques, as well as teachers who were patient and explained things clearly. Pedagogic knowledge is essential for managing learning. Knowledge about classroom management, teaching preparation, teaching and testing skills and the use of teaching aids are needed.

Teaching and learning occur in context and it is not possible to separate learners or the teacher from it (Lubisi, 2009). In the present study, pedagogical content knowledge has been identified as an important aspect in terms of the impact teachers may have on improving poor performance in Physical Science. It is recommended here that relevant school-based, clustered, provincial and national workshops targeting Physical Science teachers should be conducted if the usefulness of PCK is to be enhanced. Such workshops, which would be part of continuous professional development, should provide a platform on which teachers share their knowledge, strategies that work problems and frustrations, as well as allowing them to be up to date with innovations in education in general. It is critical that necessary equipment, such as books, laboratory equipment and chemicals be supplied to schools in good time for their use to be maximised.

While the involvement of teachers in PCK-related training may be a medium- to long-term event it is also only fair that an enabling and conducive learning and teaching environment that gives all the stakeholders a fair chance to perform at their best be generated, as is the case in the best performing schools (Makgato & Mji, 2006). They further indicate that even those that offer Physical Science do not have facilities and equipment to promote effective teaching and learning. This situation has resulted in the teaching of Physical Science, for example, remaining at a theoretical level without any experiments to enhance understanding and application of knowledge, and these happen to be schools in which learners as well as teacher performance in the subject is unacceptably low (Makgato & Mji, 2006).

2.2.1.4 Teachers' competence

The characteristic of competence is fundamental to a teacher's pursuit of excellence, but as Vallicelli (2012) indicated, it is only useful if the teacher is able to perform. The improvement of learner achievement is largely dependent on a competent teacher (National MST, 2001). After a study conducted by the Centre for Development and Enterprise (CDE) on the Physical Science curriculum, they suggested that teachers be competent in intellectual skills and strategies for its successful implementation, in which an important learning outcome is the development of learners' intellectual abilities, an important one being the

competency of teachers. As competence in Physical Science is essential for performing subject-related activities, so competence in intellectual skills and strategies is essential for performing mental activities. An increase in competence in this aspect could be expected to lead to more effective and appropriate learning. It would enable learners to organise and store knowledge more efficiently and to recall and apply it more effectively. Furthermore, this competence would help to build positive attitudes, increase self-confidence and promote the ability to solve everyday problems.

Effective Physical Science teaching should include practical activities to enhance understanding of the subject (Muwanga-Zake, 2006). Teachers often claim that lack of equipment and laboratories prevent them from teaching Physical Science practically, however, there is evidence that teachers who have equipment do not use it. It appears, therefore, that apart from work overloads the main reason teachers do not use practical approaches is that they are deficient in practical skills and do not understand the concepts they are supposed to teach. This claim is well demonstrated in schools that have science equipment. For example, schools that participate in the ZENNEX project have *Somerset Micro Science* kits, and all of the high schools sampled in Butterworth had some Science teaching equipment. In the 21 schools visited, only five had attempted to use the equipment supplied to them. The equipment was found to be gathering dust or was neatly stored in boxes that had not been opened in 16 of those schools. Similarly, visits to three Masifunde Project schools in the Free State Province during 2000 revealed an assortment of unused Science teaching equipment. All schools had some expired chemicals and broken or poorly maintained Physics equipment, some of which teachers could not identify. Under-utilisation was caused by deficiencies in practical skills and conceptual understanding of Science (Muwanga-Zake, 2006)

A discussion on competence, according to Vallicelli (2012), focuses on three important notions, namely preparation, knowledge of subject area, and defined pedagogy. The first, preparation, prepares the professional for the adversity of the classroom. From language and cultural barriers to socio-economic differences, all teachers face deterrents in the classroom that must be broken down by

individualised techniques. Thus, by bridging these barriers the teacher will be better prepared for classroom management and create an effective learning environment. Furthermore, by doing this, the professional teacher leads learners by his or her example, that is, one who is prepared for difficulties will be able to overcome them. Professionals are expected to have the necessary expertise to do their work. The status of a profession has in part been a reflection of its identification with a distinctive body of knowledge (Shon, 2006).

2.2.1.5 Teachers' Experience

Of the measurable characteristics isolated for study, teaching experience has consistently been linked to learners' scores. On average, beginning teachers produce smaller learning gains in their students compared with more seasoned ones. Most of the studies show that teachers grow in effectiveness over at least the first five years on the job, though the benefits of experience are less clear after that point (Harris & Sass, 2007). The amount of teaching experience, teachers with less than three years of classroom practices, is less effective (Darling-Hammond, 2000).

Several studies have found a positive effect of experience on teacher effectiveness, specifically; the "learning by doing" effect is most obvious in the early years of teaching (King Rice, 2003). The South African Institute of Race Relations, 1997/1998, indicated that some Physical Science teachers generally had a low level of teaching experience. Almost 40% had less than two years' experience teaching the subject. Edusource (1997) added that approximately 42% of Physical Science teachers had only one year of training. There is also a lack of Science-teaching experience in Physical Science, with nearly 40% (taught in Grades 10–12) having fewer than two years' teaching experience.

2.2.2 Factors indirectly related to teaching

This study categorises factors indirectly related to teaching as those that depend on teachers' decision to enhance their quality of teaching. According to past research, they predominantly relate to teacher professionalism, which is inseparable from teacher quality. Biswal (2005) indicates that teachers must be dedicated and considerate, an idea that entails the profession being in the hands

of teachers who can demonstrate an understanding of the knowledge and thinking that underpins the actions one takes. For Day (2004), teacher professionalism is the quality of practice, as indicated by the manner of conduct within an occupation, and how members integrate their obligations with their knowledge and skills. Similarly, Adendorff (2001) argues that professionalism in teaching is best defined and described not in terms of pay or status or qualifications but by looking at the distinctive kinds of actions and judgments that teachers typically make. Professionalism is also about hard work, self-sacrifice, nurturing and inspiring, about putting in extra hours and following it through, without any thought of reward except knowing that one has done a good job (Rice, 2010).

According to Douglas (2005), teaching is a profession and teachers are professionals. Nixon (2001) defines professionalism as the quality of being a professional, and holds certain expectations of standards, standing and connotations of an ethical and personal mission. He also portrays teaching as one of the most prestigious occupations, founded on systematic knowledge, lengthy academic and practical training, high autonomy and a code of ethics. Parker (2011) argues that teachers should focus on their work; become professional in their outlook, be knowledgeable and committed, and develop professional judgement, ethics and ethos. Teachers should be able to work and develop within a system as professionals: “professionalism is not necessarily about the qualification race, but about something different and much harder: training around the way in which things work”.

According to Rice (2010), the reason the teaching profession has lost the respect of those that it should serve is that teachers no longer exercise the moral authority vested in it, which has led to the breakdown of professional and personal ethics and discipline. He also argues that some teacher unions, especially those representing majority groups, resist any attempt to enforce standards of professional behaviour or competence. Their contribution to undermining the profession’s ethos and moral authority cannot be underestimated. Workers’ rights have been advanced at the expense of professional ethics and dedication.

The following factors were investigated as those that are indirectly related to classroom teaching as determinants of teacher quality, namely professional

values, professional conduct/ethics, teachers' behaviour, teachers' attitudes, teachers' motivation, interest and commitment.

2.2.2.1 Professional values

Douglas (2005) indicates that the nature of professional values for teachers is difficult to identify. This rests in some ways on the dual understandings of the responsibility of teachers to the state rather than the client, and is governed by a state-initiated code of conduct. The issue of professional values has been central but controversial in the early years of post-apartheid education, when dysfunctional conditions in schools led to questions about shortcomings in teacher behaviour, and more recently when teachers were blamed for poor learner performance in public examinations. One media report, which is an example of many published in the South African press following poor matriculation results, noted widespread and regular absenteeism and failure to prepare for lessons or complete the syllabus by teachers (Bot, 2003). Robinson (2002) cited statistics from the Auditor-General's Report: "A total of 612 809 school hours was lost between January and March 1999 due to teacher absences in the seven provinces investigated".

The Centre for Development and Enterprise (CDE) reported that some South African teachers spend less than 50% of their teaching in class each week and many play truant on Fridays. Pitout, Windell and Smith (1993) believe that teachers should demonstrate authentic values and qualities required for the profession. Issues such as public drinking, being drunk at work and absent from the classroom do not feature in the characteristics of teacher professionalism. One of these is their capacity to set and maintain a standard through self-regulation. Morrow (2007) asserts that members of a profession need to take responsibility for their own professional actions. The Manifesto on Values, Education and Democracy (2001) argues that there are teachers who work hard, teach well and provide good role models for their learners, but they cannot act as role models if they are not valued and cherished members of their communities or do not have a sense of the nobility of their calling. Conversely, SACE (2002:10) maintains that there are teachers who do not "act in a proper and becoming way" and who bring the teaching profession into disrepute.

In research conducted in KwaZulu-Natal by Douglas (2005), more serious teacher misconduct included physical assault, corporal punishment and sexual abuse of learners. The Medical Research Council released a study in 2002 revealing that one-third of rapes committed on schoolgirls under the age of 15 were by teachers (Bot, 2003). Public reports about the minority of teachers who committed offences gave rise to general criticism of teachers as a body, which has both damaged their standing and generated public demand to improve professional values through better management and policing of teachers.

2.2.2.2 Teachers' professional conduct / ethics

The manner in which a teacher carries himself or herself is a reflection of one's classroom, school, community, and educational system. Conduct is a representation of how well one takes care of oneself, from aesthetics to language and behaviour. However, these are minor qualities of conduct, which also includes one's ability to initiate and maintain communication with all the parties involved in education, that is, learners, fellow teachers, school board, administration, and parents (Vallicelli, 2012). Weber (2005) concedes that a teacher is a role model and must model proper manners, dress, behavior and ethics at all times. Mphahla (2009) adds that teachers should also possess an exemplary character and way of life.

Edutech (2001) views ethics as what is good or bad and that which deals with a moral duty and obligation, not only to oneself but to others. Through ethics, teachers translate knowledge, skills and abilities that enable learners to make informed and responsible choices. They face an enormous challenge in performing their duties as they are required to act professionally and, especially, to act ethically (SACE, 2002). Babbie and Mouton (2002) support these arguments by acknowledging that people have personal knowledge and self-understanding, as well as moral insight into what is right and wrong.

Professional ethics are embodied in the SACE code of conduct intended to provide teachers with implicit values and standards for their behaviour. SACE responded by developing a code of conduct for teachers, which in South Africa represents a reactionary managerial response to control a perceived lack of

professionalism among teachers, and as such does not enhance their professional status. SACE (2002) states that the ethics of the profession influence the way teachers act in their relations with other people.

In an attempt to set, maintain and protect teacher professionalism, the South African Council for Educators (SACE) was established in 1997, having as its function the establishment of professional ethics for teachers. In its code it mentions the following key values in relation to teacher professionalism:

- Act in a proper and becoming way, such that teacher behaviour does not bring the teaching profession into disrepute;
- Act with integrity, honesty and self-discipline;
- Acknowledge, uphold and promote basic human rights, as embodied in the constitution of South Africa;
- Exercise authority with compassion (SACE, 2002).

The NSTA (2006) position on teachers' professional conduct is that, as leaders of learners, teachers of Science must uphold the highest standards of ethical behaviour and be positive role models by:

- conducting themselves as responsible and ethical citizens in school and community environments and activities;
- protecting, respecting, and empowering all students;
- reflecting a professional image to learners, parents, and the community through appropriate speech, attire, and actions.

2.2.2.3 Teachers' behaviour

The South African Council for Educators (SACE) has been given the mandate as a professional controlling body for teachers in South Africa (*Education Law and Policy Handbook*, 1996). It contains a code of ethics for teachers, which maintains that the education profession is trusted by the public with responsibility for living up to the highest ideals of professional service (Adendorff, Mason, Modiba, Faragher and Kunene, 2001). In social life, the teacher portrays the profession of which he/she is a member whenever appearing in public (Day, 2004). The main

focus is the responsibility and character, as shown by acting as a sober, honest and emotionally stable human being. This requires more from the community as it expects the teacher to be an ideal model for the children.

Moore (2004) believes that a good teacher has self-discipline and bears great responsibility. Studies have singled out behaviour as a clearly defined feature of teacher professionalism, and as all the aspects of the teacher's activities can be observed, behaviour represents the outward life of individuals, which is public knowledge and which can be noted dispassionately. Similarly, Day (2004) viewed teaching as a values-led profession in which the practitioners are characterised by behaviour which shows dedication and commitment. What the teacher does in the work place reflects a bonded characteristic with the profession (De Bryn et al., 2002).

The positive characteristic behaviour of professions includes teachers who commit themselves to be guarded by the code of professional ethics (SACE, 2002). The University of the Witwatersrand (Wits) Education Policy Unit (EPU) (2005) indicates that teaching as a career has low public status, and the image of teaching as portrayed in the media also tends to be negative. This is sometimes compounded by the lack of professional behaviour by teachers, as in drunkenness and absenteeism. Many teachers have internalised a negative image of their work, experiencing a lack of confidence and low morale. It is expected that teachers observe punctuality and appropriate tidiness and dress, and it is not possible to demand such behaviour from learners if the teacher does not set the standards (Townsend Hall, 2012).

2.2.2.4 Teachers' attitude

The impact of teachers' attitude to working with learners cannot be underestimated. As well as the content knowledge and skills developed in teacher development programmes, soft issues such as change in attitude, which can boost the morale for teachers, should be included (Rice, 2010). A study on professional attitudes conducted with 1,200 Science teachers by Kriek and Grayson (2009), revealed that various unprofessional attitudes were widespread in schools, such as being late for class, not preparing for class and omitting sections of the syllabus

with which teachers were not comfortable teaching. The confusion between professionalism and labour relations has affected teacher attitudes negatively and led to lack of accountability (MST Gauteng 2009-2014).

Parker (2011) concedes that teachers should take on more responsibility for their work and become resourceful, not always expecting to be told what to do or to be given resources. This requires a change in attitude but, as Weber (2012) states, although teachers are often frustrated, overworked and underpaid, they must remember that they chose their profession because they love their learners and their content area. A school is no place for complaints or negativity and teaching involves modelling a positive attitude towards the curriculum, school and learning in general. Teachers who reveal a caring attitude towards learning and the learning environment help to instil and reinforce similar attitudes in their learners.

2.2.2.5 Teacher motivation

Teachers play a number of other social roles in the teaching/learning process, making them social agents. They are often motivators for learners, encouraging or reproving them as appropriate. The role of the teacher as social agent is an important part of the learning process, but different individuals interact with a teacher and other learners to widely varying degrees. These individuals are self-motivated, do not require any third party encouragement to learn, and can seek out and assimilate the required body of knowledge.

To produce an effective workforce in the Science fields, the education system in the country needs motivated Physical Sciences teachers. The prime reason often stated by learners for going into Science careers and doing well in the subject is a motivated teacher who in turn motivated them. Dedicated and inspiring Physical Sciences teachers have the potential to change performance in the schools, and the best teachers are passionate about their subjects and inspire and spark learners' interest (Howie, 1999**)**. Learners' performance is enhanced by constructive homework assignments and quality interaction by motivated teachers. When teachers do not provide these, learners' performances suffer (Mizala, Romaguera and Reniaga, 2000).

2.2.2.6 Teachers' interest

Danielson (1996), in her contribution to the Education Policy and Leadership Centre, Harrisburg, Pennsylvania in May 2002, indicated that teachers who show interest in their subject should demonstrate it. Furthermore, those who have a high standard of performance are reliable and dedicated, so becoming active rather than passive, showing learners a genuine interest in learners' progress (Vallicelli, 2012). Mphahla (2009) concedes that when teachers show interest in their work they become effective mentors to their learners, not only in issues that are not necessarily related to the content but also those which might have an impact on their learning. They guide and support learners to ease them through difficult transitions, smoothing the way, enabling, reassuring as well as directing, managing and instructing. They are able to unblock learner's ways to change by building self-confidence, self-esteem and a readiness to act, as well as engaging in continuing constructive interpersonal relationships.

Moore (2004) comments that good teachers have self-discipline and bear responsibility, as indicated by the patience, enthusiasm and interest both in the subject and in the learners they teach. Mphahla (2009) argues that low morale and interest in Physical Sciences perpetuates continuous underperformance in the subject, as shown by high rates of absenteeism and truancy. When teachers are late or absent from work, teaching time is reduced. Jansen (2011) concedes that too much time is wasted by some teachers at school, too many teachers being absent and too little accountability demanded by the government.

In research conducted by Muwanga-Zake (2006) on the use of practical activities to reinforce the teaching and learning of Physical Sciences, it was found that some teachers do not show interest in understanding how new equipment works, for example, by not reading instruction manuals that accompany it. This results in many schools failing to perform practical activities at schools, even though they have the equipment to do so.

2.2.2.7 Teachers' commitment

Rice (2010) describes teachers' commitment in the teaching profession in terms of caring for learners, both in terms of academic issues and some issues that may

affect them, such learning barriers, learners who are slow to grasp content and the level of commitment to help them. Commitment relates fundamentally to the question of teacher identity, conscience, and the ways of knowing and being. Unless teachers are committed and disciplined professionals who take their authority seriously, little can be achieved. Theron and Dunn (2006) add that in spite of being highly qualified and experienced, some teachers have low morale and poor commitment. A report conducted by Makgato and Mji (2006) also revealed that another cause of underperformance in the school was non-completion of the syllabus by teachers, which is caused by them spending too much time teaching content with which they are comfortable, and which also happens to be easy for learners, whilst neglecting challenging concepts.

The CDE report found that whilst most teachers have the necessary qualifications, some spend too little time in class others simply teach badly (Ndaba, 2011). Education policy expects teachers to spend 64% to 79% of their time teaching over a 35-hour week, but, on average they only spend 46%, and progressively less on teaching and other school-related activities as the week progresses, with very little teaching occurring on Fridays in many schools. In a message by the Minister of Basic Education, the University of Western Cape rector and vice chancellor Professor Brian O'Connell, on the 2008 final matric results of 60.7% said that there has been a discourse about national education and no increase in teacher consciousness about their role, no ownership or passion on the part of the pupils, and a lack of commitment on the part of the role players, including communities.

The overall pass rate in 2009 was 60.6%, with a Physical Science pass percentage of 50% nationally. The Development Bank of Southern Africa education policy analyst, Graeme Bloch, indicted that the results showed there were problems throughout the education system (Keet, 2010). The Manifesto on Values, Education and Democracy (2001) defined teacher professionalism as relating to the inculcated behaviour of teachers who commit themselves to the act of teaching by demonstrating the values that the profession is meant to uphold. Teacher commitment was closely associated with job satisfaction, morale, motivation and identity (Day, 2004).

Adendorff (2001) viewed teacher commitment as showing the extent of loyalty to the profession. As teachers constitute a strategic factor in the education system, their commitment is viewed as reflecting the competency of teaching professionals (Adu & Olatundum, 2007). Previous studies further reflect that a teacher is destined to touch people's lives permanently (Petty, 2002), and in that light this study will look at commitment of teachers to learners, learning, teaching and quality. If one looks at schools that consistently produce good results, what stands out is a dedicated staff with strong professional ethics. Teachers who stay after school to help learners and take interest in their achievements, prepare for their lessons, mark written activities and are involved in extra and co-curricular activities, are professional, whereas in the vast majority of schools, in particular those that are underperforming, absenteeism is a norm, teachers do not arrive on time and leave the school before time, lessons are not prepared for and written work is not marked, and there are no extra or co-curricular activities (Rice, 2010).

2.2.2.7.1 *Commitment to learners*

The National Board for Professional Teaching Standards (NBPTS) defines teachers who are committed to learners as those who:

- believe all learners can learn;
- treat learners equitably, recognising individual differences and accounting for these in their practice;
- adjust their practice based on observation and knowledge of their learners;
- understand how learners develop and learn;
- develop learners' respect for learning; (The Education Policy and Leadership Centre, 2002)

Weber (2012) adds that a professional teacher will get to know his/her learners and listen to their problems, questions and concerns, treating each one with respect. For Townsend Hall (2012), a professional teacher needs to be confident without being arrogant. Proper planning is another crucial requirement of professionalism, and when a teacher enters the classroom he/she should have all

the required materials and lesson plans ready. Poor preparation is particularly problematic.

2.2.2.7.2 *Commitment to teaching*

Commitment to teaching results in effective teaching, and too often the ineffectiveness of teacher instruction is not regarded as contributing to ineffective learning. Within the professional culture of teaching it is commonly believed that if something is taught it is automatically learned. If it is not learned the problem is assumed to lie with the inadequacy of the learners' ability, motivation or persistence (Nuthal, 2004).

The National Board for Professional Teaching Standards (NBPTS) indicated that teachers who are committed to teaching should be responsible for managing and monitoring learning by:

- creating environments that engage learners and use time effectively;
- engaging others (both learners and colleagues) to assist them;
- being aware of ineffective and damaging instructional practices;
- setting norms for social interaction;
- assessing the growth of both individual learners and the class as a whole;
- being able to explain a learners' performance to parents.

(The Education Policy and Leadership centre, 2002).

2.2.2.7.3 *Commitment to learning*

Teachers' learning skills refer to those that teachers have to attain when collecting, processing and summarising data with the aim of developing oneself towards lifelong learning. It is also the ability to obtain knowledge in the field of cognition, affection and psychomotor skills through observation, reading, writing, imitation, memorisation, understanding, analysis, synthesis, evaluation and memory. It refers to the ability to receive accurate signals, process information, store it in the memory and apply it to problem-solving.

There is a need to acquire learning skills, such as observing, making assumptions, and understanding, remembering, thinking and interpreting to produce effective learning. The importance of learning lies in enabling a teacher to obtain knowledge systematically, inculcate interest and liking for learning and increase knowledge and lifelong intellectual skills that enable teachers to apply them to all types of situation. Weber (2012) defines teachers who are committed to learning as those whose education does not stop with a degree. They must continually be aware of best practices in their field, including new teaching methods and materials. This usually involves postgraduate work and frequent workshops.

2.2.2.7.4 *Commitment to quality*

Weber (2012) indicates that a committed teacher is not satisfied with an average performance but rather researches and plans each lesson fully to give learners the best lesson possible. In an attempt to encourage commitment to quality Science education in schools, the NTSA statement indicated that instruction is an interdependent process that requires the active participation and shared responsibility of Science teachers, school leaders, district administrators, school boards and parents. The NTSA Position Statement (2007) called on Science teachers to accept the professional responsibility to provide all learners with quality Science education; embrace and promote their professional learning and growth; uphold and strengthen the public image of the profession; and become active leaders and advocates for quality Science education in their schools and communities. To provide quality Physical Sciences education for all learners, NSTA recommends that Science teachers should:

- show respect for each individual and value his or her identity and cultural heritage;
- recognise the abilities and strengths of learners, as well as their unique learning needs;
- model and emphasise the skills, attitudes, and values of scientific inquiry, help learners reflect and use skills of inquiry to become effective problem solvers;
- display and demand respect for diverse ideas, skills, and experiences of all learners;

- structure and facilitate continuing formal and informal discussion based on a shared understanding of rules of scientific discourse;
- orchestrate discourse among learners about scientific ideas.

2.3 CONCLUSION

This chapter has reviewed researchers' interpretations of factors related to teacher quality in terms of actual classroom teaching and teachers' decisions to enhance their own teacher quality. Both factors are interrelated and play important roles in the quality of education given to learners. The researcher categorised factors that are indirectly related to teaching, those that are the teachers' decisions to enhance quality and those that relate to teacher professionalism, namely behaviour, conduct, and personality. It also examined those that are directly related to classroom teaching, as requirements for teaching. The arguments raised indicate that the performance of Physical Sciences not only depends on what teachers do in class but also on what they do outside of the classroom and how.

The research methodology and design for this study is discussed in the following chapter.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The main focus of the study was to investigate how factors related to teacher quality affect the performance of Physical Science in Tshwane South district. Since the concept of teacher quality depends on many factors, this study focused on data collected from and about teachers on how their teaching practices affect the performance of learners. The performance of learners, especially at the end of grade 12, is used by stakeholders to conclude on the outcomes of the quality of education received by learners. This is because learners have to either pursue further studies at tertiary institutions or get in the world of work where it is assumed that they will apply information learned at school. Poor performance at the end of grade 12 implies that learners are not ready to apply information acquired, whilst good performance implies that learner are ready to perform well in life after basic education, hence the senior certificate is required to access higher education and to apply for most jobs.

The researcher acknowledges that some of the many factors that affect the quality of education in South Africa include amongst others the frequent changes in the curriculum and schools that are not equally resourced. The researcher also acknowledges that the changes in the curriculum and the resources at schools may not provide consistent data on the quality of education received since there are schools that coped well with the curriculum changes and other schools that still produce satisfactory results amidst being under resourced. The researcher decided to collect rich data on and about the teaching conduct and practices of the teacher in an attempt to make conclusions on the quality of education received by learners.

In an attempt to answer the primary question:

- **How do factors related to teacher quality affect the Grade 12 Physical Science performance in Tshwane South District?**

Available data was analysed to address the first secondary question:

What is the status of teacher quality in Tshwane South Physical Science teachers?

Data collected for the first secondary question was reinforced by data collected to by the second secondary question:

- To what extent do factors related to teacher quality affect the performance of Physical Science in Tshwane South District through the following sub-questions :
    - How do factors that are directly related to teaching affect the performance of Physical Science in Tshwane South District?
    - How do factors that are indirectly related to teaching affect the performance of Physical Science in Tshwane South District?

This chapter presents the research design, research site, population, sampling, data collection procedures, ethical considerations and limitations to the study.

3.2 RESEARCH DESIGN

A research design describes how the study was conducted, summarising the procedure for conducting the study, including when, from whom, and under what condition the data will be obtained. Its purpose is to specify the plan for generating empirical evidence that will be used to answer research questions. This study followed a mixed method research design which included both quantitative and qualitative research design (McMillan & Schumacher, 2010:22, 27). Creswell, 2005) describes mixed methods as a procedure for collecting, analysing and mixing or integrating both quantitative and qualitative at some stage of the research process within a single study for the purpose of gaining a better understanding of the research problem.
/ Government Printing.

According to Creswell, Fetter & Ivankova (2004), there should be integration of quantitative and qualitative data and analysis in a single study. O'Cathain, Murphy and Nichol, (2007) argue that a mixed methods study has the potential to produce

knowledge that is unavailable independently, and that it can produce knowledge that is unavailable to other approaches through the creation of a wider picture, more confidence and a wider variety of views. McMillan and Schumacher (2010) contend that a mixed methods study can show how the results (quantitative) and explain why they were obtained (qualitative).

Triangulation was used so the strength of each approach could be applied to provide not only more complete results but also more validity (McMillan & Schumacher, 2005:28). The researcher simultaneously gathered both qualitative and quantitative data, merging them using both qualitative and quantitative data analysis methods, and then interpreting the results together to provide a better understanding of a phenomenon of interest. Approximately equal emphasis is given to each method, even though one can follow the other (McMillan & Schumacher, 2005:404).

Quantitative research is objective in measuring and describing phenomena with the use of numbers, statistics, structure and control (McMillan & Schumacher, 2010:23). The goal of a quantitative research is to describe the trends or explain the relationship between variables. The sample size is large and randomly selected from a large population to generalise the result of that population. Convenience sampling, which Maree (2007:255) describes as used to select individuals who are available and willing to participate in the study, was used to collect data.

The type of quantitative design that was used was non-experimental, to describe things that have occurred and examine the relationship between them without direct manipulation of experience. The type of non-experimental design used for this quantitative research was descriptive and correlational. The former simply provides a summary of existing phenomenon by using numbers to characterise individuals or a group. Its purpose is limited to characterising something as is. The latter is concerned with assessing relationships between two or more phenomena, usually involving a statistical measure of the degree of relationship (McMillan & Schumacher, 2010:24-25). For this study, quantitative data was collected through questionnaires and data collection instruments for factors related to teacher quality.

In qualitative research, data may be collected in face-to-face situations by interacting with selected persons in their setting. It is used to describe and analyse peoples' individual and collective social interactions, beliefs, thoughts and perceptions (McMillan & Schumacher, 2010:315). Qualitative research emphasises gathering of data on a naturally occurring phenomenon, mostly in the form of words rather than numbers (McMillan & Schumacher, 2010:26-27). In qualitative research the researcher does not attempt to manipulate the phenomenon of interest (Maree, 2007:79).

The sample size for qualitative research is small and is purposefully selected from those individuals. The researcher serves as the instrument of data collection and asks the participants broad, open-ended questions (Maree, 2007:257). A qualitative design for this research followed an interactive and non-interactive approach. Interactive data was collected through individual interviews with principals and teachers to address their own perceptions of factors directly and indirectly related to teaching and how these affect the performance of Physical Sciences at their schools, whereas non-interactive data was collected through lesson observations of teaching practise and moderation of learners' written tasks.

3.3 RESEARCH SITE

A research site is a place in which the research study occurs (Maree, 2007), in this case schools in Tshwane South District, Gauteng province, in which the researcher is a Physical Science facilitator. The rationale behind the choice was the researcher working in the province and specifically with schools in the district mentioned. This made data collection easy for the researcher, since the schools were easily accessible. The accessibility of teachers also made the study feasible. The researcher chose to conduct the research in township public schools and independent schools that had black learner only, since the status of most of the teachers and learners were mostly similar in terms of teaching resources and the qualifications of most teachers.

3.4 POPULATION

According to findings by McMillan and Schumacher (2010), a population is a group of elements or cases, whether individuals, objects or events, that conform to

specific criteria and to which the researcher intends to generalise the results of the research. The Grade 12 Physical Science teachers in Tshwane South district were chosen for this research because all schools wrote the same final examinations and therefore the results would be used to fairly establish how factors related to teacher quality affect the performance of Physical Science in Tshwane South District.

3.5 SAMPLING

A sample is a small group of subjects or participants from whom data is collected (McMillan & Schumacher, 2010:119). Since the research followed a mixed method design, convenience sampling was used to collect quantitative data. Convenience sampling is used to select individuals who are available and willing to participate in the study (Maree, 2007:255).

Convenience sampling was used to collect select 56 Grade 12 Physical Science teachers in 43/78 township and city independent schools in Tshwane South district. All of these teachers were teaching Physical Science at the time of the study, they taught at schools whose socio economic status were the almost same in terms of human and physical resources. They were all black teachers, teaching black learners from townships which were all previously disadvantaged. The remaining thirty five schools were not chosen for the research since these were varied in terms of the learners enrolled at the schools, teachers teaching there and available resources at these schools.

In order to collect qualitative data, purposive sampling was used for eight grade 12 Physical Science teachers in six township schools and one city independent school. Purposive sampling, according to Maree (2007:257), allows the researcher to select participants because of the defining characteristics that make them holders of the data needed for the study. The type of purposive sampling used was stratified purposive sampling, according to pre-selected criteria relevant to a particular research question, in this case Grade 12 Physical Science teachers in Tshwane South District who had been teaching Grade 12 for more than three years, a sample of their learners' tasks (high performers, middle performers and low performers) and lesson observations.

The performance of sampled schools in Grade 12 Physical Science at the end of 2012 were within a range of 0-29% (level 1); 30-39 (level 2); 40-49 (level 3); 50-59 (level 4); 60-69 (level 5); 70-79 (level 6) and 80-100 (level 7), as the performance descriptors prescribed in the National Curriculum Statement (2002) and the Subject Assessment Guideline (2008). The seven schools sampled to collect qualitative were amongst the 43 schools which the researcher used to collected quantitative data. Initially the researcher sample teachers from seven township schools categorised as level 1 to 7 as in the Subject Assessment Guideline (2008). However, no township school matched the level 1 category, so the researcher added an independent school as the seventh school for level 1. It was chosen for this study because during the period of the study (the year 2012 and 2013), no township school in Tshwane district got a pass percentage of less than 30% in Physical Science. The researcher sought to establish the cause for the schools performance.

3.6 DATA COLLECTION PROCEDURES

Data collection involves gathering information about the variables in the study (McMillan & Schumacher, 2010:130). The researcher decides where data would be collected, when it would be collected, by whom, and if necessary specifics of the experiment (McMillan & Schumacher, 2010:133). Data collection procedures entail gaining access to the research site, presenting oneself to the research subjects, designing data collection instruments, conducting a pilot study and actual collection of data.

3.6.1 Gaining access

The following steps were followed before obtaining data from and about the participants:

i. Using the “overt access” method to gain permission to conduct the study at the sampled schools from the GDE, the district office and school principals, as well as from participating teachers. Overt access is used when permission for continuing is granted by gatekeepers, in this case the GDE, school principals and the participants (Denzin & Lincoln, 2000). Appendices A - G are attached.

ii. Using available data to obtain information on Physical Sciences pass percentage of the schools in 2012. This method is “covert access”, since the participants did not know that such information was accessed and would be used for research purposes, however, the chief education specialist for curriculum was informed that the information would be used for research purposes.

3.6.2 Presentation of the researcher to the site

Presentation of the researcher to the site took place after permission was granted by the provincial education office and the district officials responsible. The researcher met with principals of sampled schools first to present a permission letter from the GDE and ask for permission to conduct the study at their schools, then to meet with sampled teachers to establish first if they were prepared to have studies conducted with them. During the meetings with principals and teachers the researcher explained the purpose of the study, how it would unfold, the choice of time for it to be conducted, and that information gathered would be confidential and used only for the research purpose. During the presentation all schools agreed to the arrangements, except for one teacher who felt uncomfortable with the facilitator carrying out a study on her and who was excused.

3.6.3 Data collection instrument

Data collection instruments are tools used to gather information required for the study, and should establish the reliability and validity that the researcher needs (McMillan & Schumacher, 2010:133). Quantitative data was compiled using tables of summaries for data collected on the performance of Physical Science, teachers’ qualifications, experience, workshops attendance and the status of school based assessment (practical tasks), and was presented in tables and graphs. Other tools used to collect quantitative data were questionnaires which addressed the same questions for all participants (Appendix H).

Qualitative data instruments were mainly used to answer the second sub-question of the second secondary question. Instruments used to collect qualitative data were predesigned classroom observation templates (Appendix I), predesigned interview questions for principals and Grade 12 Physical Sciences teachers

(Appendices J and K) and interview questions conducted after classroom visits (Appendices L-1 to L-7).The classroom observation instrument was adapted from the classroom observation template used in Tshwane South district to monitor classroom teaching and assessment practices. Data collected through the classroom observation template was mostly observable teaching and assessment practice. The analysis of results was the only data that the teacher had to provide to the researcher. Interview questions for the principals and the teachers prior to classroom visits were designed by the researcher to establish teachers understanding of what factors indirectly related to teaching meant to them and their perception on how both factor directly and indirectly related to teaching affected their learners performance and their teaching practices.

3.6.4 Phases of data collection

Data collection period was split into five phases. All data was collected after the approval for the study by the GDE, school principals and participants.

3.6.4.1 First Phase

The first phase focused on collecting data on learners' Grade 12 Physical Science performance from the previous year, as well as term 01 formal test mark analysis in 2013, which the researcher could access from the provincial coordinator and the district office. The previous years' learner performances were the Grade 12 mark analysis of the final examination for 2012 for all schools in the district. The researcher used the 2012 final results to get an overall picture of the performance of all schools in the district and categorise their performance according to the performance indicators as stipulated by the Subject Assessment Guideline (2008), and according to this study. This also assisted the researcher to sample schools for the study, as well as to choose schools with similar performance for the pilot study. The 2013 term 01 formal test results were used to check if the performance in the subject was sustained, increasing or decreasing in comparison to the final Grade 12 results of 2012, since most of the examinable content was carried out in term 01.

The researcher used data collected in the first phase to establish the status of teacher quality in Tshwane South district as a basis to answer the primary

question for this study on how factors related to teacher quality affects the performance in Physical Science in the district chosen. During this phase the researcher did not interact with the participants. Data collected was summarised in tables and analysed.

3.6.4.2 Second phase

The second phase focused on information about teachers which the researcher had categorised as those that directly affect teaching practices. This data included teachers' recent qualifications in the teaching of Physical Science, years of experience in teaching Physical Science in the FET phase (Grades 10-12) and record of workshop attended for the previous three years. Data was collected from teachers through telephonic and direct conversations during the normal school visit routine which is the researcher's job description. Even if the researcher had access to some data it was considered that it could have changed, hence the researcher collected data afresh from the teachers. Some of the data in the second phase was collected from 56 Physical Science teachers in 43 schools out of the total of 78 that offered Physical Science in the district during the time of the study, and some only from seven township and city independent sampled schools. The reason for this was to investigate data from a larger group of factors affecting the performance of Physical Science, then collect data on a smaller scale for sampled teachers as a representation of a larger group. Data collected was summarised in tables and analysed.

3.6.4.3 Third phase

This phase included administration of questionnaires to participating teachers. Data requested from participants included qualification, employment status, experience, post level, workshop attendance and some questions based on individual teachers' own rating and perceptions of their teacher quality in accordance with the two factors identified in the study. These included teachers' opinions on how they perceived experience, qualifications, teacher development programmes, subject knowledge (both content and pedagogical content knowledge) and teacher competence to affect the performance in Physical Science. The researcher only interacted with the participants when the

questionnaires were submitted to them to emphasise that they would be used for study purpose and not as the researcher's daily work as their subject facilitator. The researcher used data collected to establish how factors identified affected performance in Physical Science.

3.6.4.4 Fourth phase

The fourth phase included separate interviews with principals and Physical Science teachers at their schools, conducted after school in accordance with the appointment. Interview questions that addressed factors that directly and indirectly related to teaching affected the performance of Physical Science as well as how teachers perceived themselves concerning these factors. These interviews were carried out after the administration of questionnaires and before school visits, so that the other instruments could reinforce data collected through these interviews. For this data the researcher depended only on what the participants said.

3.6.4.5 Fifth Phase

The fifth phase focused on classroom observations that included the completion of a classroom observation template designed by the researcher, moderation of written tasks and interviews after lesson observations for issues that were not properly addressed by the template and learners' books. The classroom observation instrument focused on the lesson preparations, lesson presentation and assessment, history of learners' formal and informal written task in terms of quantity and quality, teaching resources, intervention classes and analysis of results for formal tasks. The researcher moderated written tasks to quantify the data required for this study. Interview questions after classroom observations depended on the observations made during classroom observations and were not the same for all teachers, nor were they prepared beforehand. Data collected in phase five was meant to establish how teacher quality as reflected by everyday teaching affects the performance of Physical Science.

3.6.5 Conducting a pilot study

A pilot study is defined as a miniaturised walk-through of the entire study (Babbie 1990:220). McMillan and Schumacher (2010:202) recommend that researchers

conduct pilot tests of their questionnaires before using them. To do so, it is best to locate a sample of subjects whose characteristics are similar to those that will be used in the study. This exercise helped the researcher to establish whether the timeframes for the study were realistic and if the questions were clear for the participants. The researcher planned to conduct the pilot study to collect qualitative data from six township schools categorised as level 2 to 7 and one level 1 city independent school same as the category and number of schools planned for the study. One grade 12 Physical Science teacher was chosen for the pilot study from each school. The pilot study allowed the researcher to establish gaps in the instruments, ambiguity of the questions and misunderstandings by pilot participants which indicated areas that needed to be restructured in the instruments.

For the pilot study, only teachers were chosen to participate and not their principals. Once the required number of pilot participants was achieved, the researcher designed questionnaires and interview questions that would be used for the study. The questionnaires requested data on qualifications, employment status, experience, post level, workshop attendance and some questions based on individual teachers' own rating of their opinion and perceptions of their own teacher quality. Interview questions included questions on teachers' opinions and rating of their professional conduct.

Although the pilot study presented challenges in terms of replacing some participants it also allowed the researcher to anticipate challenges in the study. The pilot study exercise was strenuous for the researcher since the instrument had to be left with the participants and collected after a certain time, and this was costly and time-consuming. Two of the initially selected pilot participants refused to participate and had to be replaced, an exercise that presented a challenge since they had to be replaced by teachers from the same category of performance as identified for the study. The researcher wished to give all pilot participants data instruments at a similar time, with only two or three days in between. The replacement process lasted for a week. During the pilot project, participants were given questionnaires and interview questions to answer in three days.

The researcher asked pilot participants if they would be able to complete the questionnaires after three days and they initially all agreed that they would. By the third day some participants had not completed all instruments and did so quickly so as to submit. The results did not provide reliable answers for the researcher; however, one of the participants the researcher chose was a master's student in Education Studies, so he took the pilot project seriously as a guide to his own studies. Two were BEd (honours) students) and their responses looked genuine. Two who were not pursuing any further studies did not show much interest, complying merely to please the researcher; who was also their subject facilitator. However, two did show commitment and because of some irrelevant answers provided the researcher realised the ambiguity of some questions in the questionnaire and had to restructure them.

The researcher accepted the responses of the five participants as a guide to conduct the study. Some responses were not what the researcher had anticipated and this indicated to the researcher that they were ambiguous. The researcher restructured some question and removed some that did not seem to address the research question.

3.6.6 Data collection

For this research, quantitative and qualitative data was collected at about the same time through triangulation. The first objective and first part of the second objective were addressed through quantitative data, whilst the second part of the second objective was addressed through both quantitative and qualitative data.

3.6.6.1 Collection of quantitative data

Quantitative data was used to address the first objective of the primary research question, regarding the status of teacher quality in Tshwane South district, and some data required for the first sub-question of the secondary objective on how factors directly related to teaching affect the performance of Physical Science in Tshwane South district. Data collected to establish the status of teacher quality in here was raw data on pass percentage of all schools at the end of 2012 and raw data on pass percentage of Grade 12 terms 01 formal test in 2013. Data collected to establish how factors directly related to teaching affected the performance of

Physical Science in Tshwane South district was raw. This data comprised of teacher qualifications, workshop attendance and teacher experience for 56 Grade 12 Physical Science teachers in the 43/78 schools that offered Physical Science at the time of the study, including the eight sampled teachers, as well as a questionnaires on continuing professional development through further study and teacher induction.

3.6.6.1.1 *Pass percentage of Physical Science for schools in Tshwane South district in 2012*

The researcher obtained Grade 12 pass percentages for all schools taking Physical Sciences in the district at the end of 2012 from the provincial Physical Science coordinator. The performance of schools, both nationally and provincially, is measured through the performance of the Grade 12 learners in the previous year. The 2012 Grade 12 results data was used in order to present an overall picture of the performance of Physical Science in the district first. This helped the researcher to make conclusions about the overall status of teacher quality in the district, a factor that the researcher deemed to provide a foundation of data required for the general performance in the district. Based on the data from the general performance, the researcher then collected data on sampled schools that performed differently across the performance criterion provided by the National Curriculum Statement (2002), to establish the causes of the difference in the performance of these schools, in order to investigate factors that affect the performance of the Physical Science for different schools.

3.6.6.1.2 *Pass percentage of Physical Science term 01 formal test in 2013 for sampled schools in Tshwane South district*

The researcher obtained 2013 term 01 formal test mark analysis from the sampled schools. The report was only made available to the researcher at the beginning of term 02, after the mark analysis for the subject had been submitted to the district assessment facilitators. The term 01 formal test mark analysis for sampled schools was used to determine the possible performance of learners at these schools since the first term was the longest of the four, and content covered in the term carried many marks that could make a learner pass in the final examination.

The researcher used the term 01 formal test mark analysis to establish the current status in teacher quality by establishing if the schools had sustained their performance, dropped or improved from the 2012 final exam results.

The researcher obtained teachers' qualifications, including in Physical Science teaching, records of workshops attended and experience in teaching Grade 12 from 43 of the 78 schools offering Physical Sciences in 2012 in Tshwane South district, including sampled schools. All three factors were recorded on the same template. The researcher obtained this information during routine school visits to schools as a subject facilitator and telephone conversations with some teachers. This data was required to establish the status of teacher quality in the district and how teaching qualifications, specifically Physical Sciences, teacher development though workshops and induction, and the experience obtained by teachers over the years of teaching Grade 12, affected the performance in Physical Sciences. The results obtained for all schools were then compared with the 2012 final ones.

3.6.6.1.3 *Questionnaire responses*

Questionnaires were given to teachers after they agreed to participate in the study. Questions included the profiles of sampled teachers in terms of age range, gender, type of employment, post level, and data on factors in this study that are categorised as those directly related to teaching, namely, teachers' qualifications, workshop attendance, teaching experience, continuous professional development, induction and subject knowledge. The researcher also asked questions to teachers on their perception about how factors identified in the questionnaire affected the performance of Physical Sciences. Teachers were given the questionnaires in term 01 and asked to complete them before the end of term 01. The researcher collected the teachers' responses during visits to schools to collect data for classroom observations.

3.6.6.2 Collection of qualitative data

For purposes of the study the researcher used classroom observations, moderation of learners' written tasks and interviews to collect qualitative data that would assist in addressing the second objective of the primary question on how factors directly and indirectly related to teacher quality affected the performance of

Physical Science. For factors directly related to teaching, the researcher collected data through actual teaching observations, moderation of learners' written tasks and some interview questions conducted after classroom visits. This data included teachers' subject knowledge and competence. For factors indirectly related to teaching, the researcher collected data through actual teaching observations and interviews. This included the professional conduct of teachers, attitude, motivation, interest and commitment.

The following procedures were followed in collecting qualitative data to address factors directly related to teaching.

3.6.6.2.1 *Classroom observations*

Observable data on factors directly related to teaching was recorded in a classroom visit template and those that indirectly related to teaching were either used for further clarity during interviews or reserved for analysis of this study. Classroom observations were made for Grade 12 teachers teaching in 2013, in terms 2 during teaching time to get reliable results on everyday teaching practices. The researcher could either make high inference observations, which are judgement or inference-based or low inference observations, when the observer recorded specific behaviour without making judgements on a more global scale (McMillan & Schumacher, 2005:207).

In this case the researcher used high inference observation in an attempt to clarify factors affecting the performance of Physical Science. Observed data helped establish teachers' subject knowledge (content and pedagogical content knowledge), competence, attitude, motivation, interest and commitment in the teaching of Physical Science. It was used to establish how these affected the performance of Physical Science. Classroom observation instruments enabled the researcher to see the uniqueness of teaching practice and where there were gaps in terms of data required to answer the research question she conducted interviews that the classroom observation instruments had not fully addressed.

3.6.6.2.2 *Document analysis*

Document analysis was made through moderation of learners' written tasks for sampled schools. Data collected was used to verify questionnaires and later interviews. It was used to add to previous data collected on the teachers' subject knowledge, competence, commitment, attitudes, motivation and interest in the subject. Moderation of learners' written tasks was carried out for three learners per sampled school, one whose performance was high, the other moderate and the other low, according to the final results of Physical Science in the previous grade, using their informal and formal tasks. This exercise was used to assess the quantity and the quality of written tasks given to learners and compare these with the previous years' performance of schools.

In term 1 of 2013 the researcher only moderated informal written tasks since at this time formal activities had not yet been completed. Term 1 formal tasks were moderated during classroom visits in term 2. This type of data was collected during a scheduled visit with the participants. Data on written task was recorded in the classroom observation instrument. The learners' tasks were collected at the beginning of the lesson to go through, as the teacher was teaching, and moderated during that time. The researcher found moderation of written tasks to provide most reliable data on what and how teaching and assessment occurred every day, and which contributed greatly to the performance of Physical Science in each school.

The following procedures were followed in collecting qualitative data to address factors indirectly related to teaching:

3.6.6.2.3 *Interviews*

The researcher used interviews to collect information about participants' social life. McMillan and Schumacher (2005) regard interviews as essentially vocal questionnaires that involve direct intervention between individuals. The techniques for conducting an interview are flexible and adaptable, with confidentiality maintained (McMillan & Schumacher, 2005:203). Face-to-face interviews were used to strengthen the cause of confidentiality and to assist the researcher to gather information, mostly on participants' understanding of how factors related

directly and indirectly to teaching affect the quality of teaching and then derive from their responses how they affect the performance of Physical Science. Some interview questions also reinforced questions posed in the observation template and a questionnaire on how various factors affected the quality of Physical Science teaching and consequently its performance. All interviews were conducted at the school in which all participants were working, that is their natural habitat.

The researcher conducted three stages of interview sessions.

3.6.6.2.3.1 *Interviews with teachers before classroom visits*

Questions for these interviews were prepared beforehand and were the same for all participants. The responses were recorded in writing. Because the researcher was a subject facilitator for Physical Science for the same schools, the participants were not comfortable with the audio recording. The researcher used a combination of structured, semi-structured and unstructured questions for this session of interviews. Structured questions were followed by set of choices, in this case *Yes* or *No*, with the respondent selecting one of the choices as the answer. Semi-structured questions were phrased in such way that allowed for individual responses. They were open-ended questions but fairly specific in their intent, and encouraged two-way communication.

Unstructured questions allowed the interviewer great latitude in asking broad questions in whatever order seemed appropriate (McMillan & Schumacher, 2005:204). These interviews were conducted with the teachers' consent after school, outside contact time to avoid interrupting school activities. They included questions on teachers' understanding and perceptions of how professional conduct, attitudes, motivation and interest affected the performance of Physical Science and to rate themselves according to these factors.

3.6.6.2.3.2 *Interviews with principals of sampled schools before classroom visits*

Interviews with principals were also conducted when principals were not engaged in school management activities after school. Interview questions were prepared beforehand and consisted of structured, semi-structured and unstructured

questions, based on information about the principals' management experience, their knowledge of the conduct and content knowledge of their Grade 12 Physical Science teachers as well as the support that they give them to ensure satisfactory performance Physical Science. All principals were asked the same questions, the aim being to establish if they were aware of factors that affected the performance of Physical Science and how supportive they were to them in ensuring satisfactory performance in the subject.

3.6.6.2.3.3 *Interviews with teachers after classroom observations*

These interviews with teachers were conducted after school on the day the lesson was observed. Questions were not prepared beforehand but depended on the observations made during classroom observations and moderation of learners' written tasks. The questions were not the same for all teachers but included factors directly and indirectly affecting the performance of Physical Science. One level 2 teacher could not be interviewed after a classroom visit since she had other lessons after the observed one and had asked to leave immediately after the last one to attend to family responsibility issues. The researcher decided to use interview responses of the other teacher to collect data required for this study.

Face-to-face interviews with principals and Grade 12 teachers also enabled the researcher to establish a broader picture of the reason behind the performance of all sampled schools, because of the repetition of some questions to both the principals and their teachers. Some of the responses reinforced data collected through other instruments, while others contradicted the teachers' responses to other instruments.

3.7 ETHICAL CONSIDERATIONS

The setting and participants should not be identified on paper (McMillan & Schumacher, 2010:133), and confidentiality and privacy of teachers and learner tasks, including information given by principals about teachers, were protected. The overall results for 2012 and qualifications, experience and workshop data for teachers in 43 of the 78 schools in the district were summarised in order to give a generic picture of how these affected teacher quality in Tshwane South district and consequently the performance in Physical Science. Teachers and principals

of sampled schools were coded when information was required from them. All sampled participants were encouraged to give information required for this study. Code names were written according to the performance indicator of that school and the number assigned to a teacher in the case of two teachers being from the same school participated in the study, for example, Level 1 School or T1 or T2 for different teachers at a school if there is more than one.

3.8 LIMITATIONS OF THE STUDY

The researcher's role as a Physical Science facilitator in the district for the same teachers could have influenced the responses of some teachers to the data collection instruments. The participants were all aware of the researcher's visit to the school and had ample time to prepare for classroom observations required for this study. The classroom observations for some teachers looked genuine, but for some it was too good. Interview responses from principals presented idealised teachers and this could be a protective measure for those from a district official. Despite these limitations, most of the responses provided reliable information and shed light on the factors that contribute to the performance of Grade 12 Physical Science in Tshwane South district.

3.9 CONCLUSION

Chapter three has outlined the research methodology for the study. This covered the incorporation of both the qualitative and quantitative study that allowed the researcher to collect a substantial amount of data which could not be addressed by one of the two. The instruments to collect data included available raw data, the questionnaires designed by the researcher, interview questions and classroom observation templates. The researcher considered all requirements for conducting a study at an institution and followed all procedure as expected. Challenges encountered with the instruments and the pilot studies were addressed. The researcher was satisfied with most of the data collected and used it to analyse the findings against the research questions.

The next chapter presents data collected.

CHAPTER 4

DATA ANALYSIS AND PRESENTATION

4.1 INTRODUCTION

The purpose of this chapter was to present and analyse both quantitative and qualitative data with the aim of addressing the primary question for this study. In this chapter, raw data which had been accessed from various stakeholders and participants has been summarised in the form of tables and graphs. Some data collected through the questionnaires and document analysis during classroom observations has also been summarised in tables. All data collected, be it raw data, responses form questionnaires, classroom observations, document analysis or interview responses, has been analysed and discussed in detail according to the data required to answer the secondary questions for his study.

4.2. THE STATUS OF TEACHER QUALITY OF PHYSICAL SCIENCE IN TSHWANE SOUTH DISTRICT

The researcher analysed data collected from the 2012 Grade 12 final results for Physical Science for all schools in the Tshwane South district and 2013 Grade 12 term 1 Physical Science formal tests marks for sampled schools to answer the question: What is the status of teacher quality of Physical Science teachers in Tshwane south district?

The 2012 Grade 12 final results for Physical Science were used to establish the overall perfomance of all schools in Tshwane South District, whereas the 2013 Grade 12 term 1 formal test results for sampled schools were used to establish the perfomance trend of Physical Science from 2012 to 2013 as a measure of the status of teacher quality in the district. The researcher used these findings to estalish how the status of teacher quality in Tshwane South distict influenced the current perfomance in Phyical Science .

After accessing the 2012 Physical Science analysis for the final Grade 12 results for all schools in Tshwane South district, the researcher analysed the results. This was done according to the codes and description for reporting and recording as

stipulated in the Subject Assessment Guidelines (2008:5) from level 1 (*not achieved*) to level 7 for (*outstanding performance*), using the pass percentage for all schools that registered this subject in Tshwane South district. The researcher further analysed performance in terms of all learners who wrote the Physical Science examination at the end of 2012 in Tshwane South district. The 2012 Grade 12 results for all schools in the district presented an overall picture of the performance of Physical Science in the district which the researcher used to measure teacher quality.

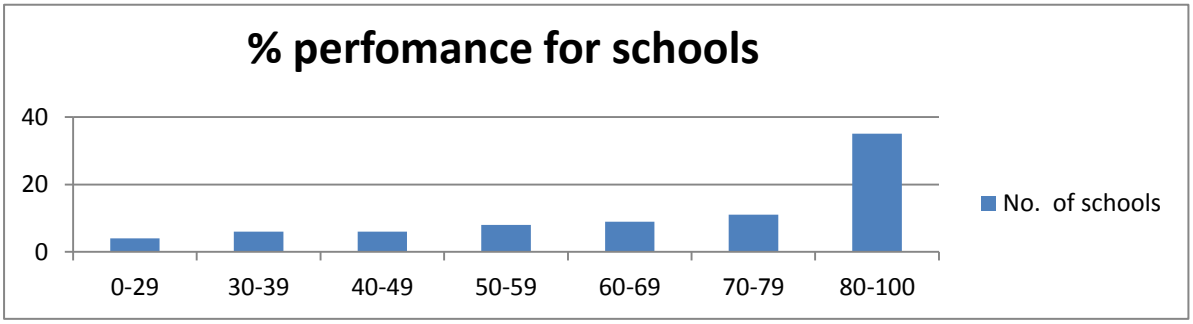
The total number of schools that enrolled learners for Physical Science at the end of 2012 was 78. The performance indicator used at the end of 2012 was within a range of 0-29% (level 1); 30-39 (level 2); 40-49 (level 3); 50-59 (level 4); 60-69 (level 5); 70-79 (level 6) and 80-100 (level 7).

The graph and table below present data on pass percentage for all schools that offered Grade 12 Physical Science in 2012.

Table 4.1: Pass performance of 78 schools that offered Grade 12 Physical Science in 2012 in Tshwane South District

Number of schools	78						
Levels	1	2	3	4	5	6	7
Pass %	0-29	30-39	40-49	50-59	60-69	70-79	80-100
School performance	4	5	6	8	9	11	35

Graph 4.1: Graphical representation of the pass performance of 78 schools that offered Grade 12 Physical Science in 2012 in Tshwane South District



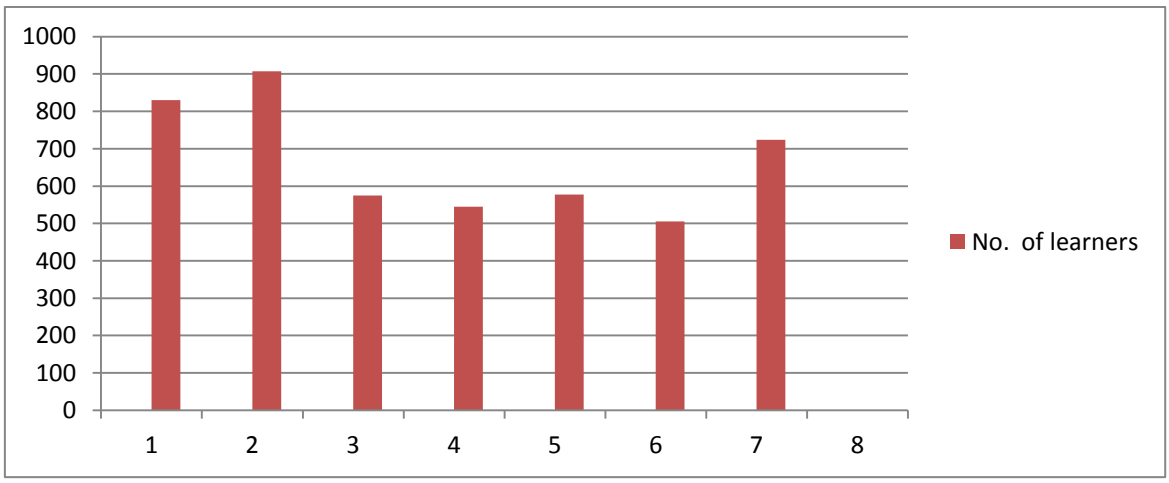
Tshwane South district obtained a pass percentage of 79,67% in Physical Science at the end of 2012, the highest in Gauteng province districts.The minimum percentage for a pass in Physical Science is 30% and the university entrance to specialise in most Science course is 60% and above. From the table and the graph the number of schools that obtained 30% and below in Physical Science was four, well below the 74 schools that obtained above 30%. Schools that obtained from 60% upwards were the most (55), more than 50% of the overall number of schools that registered the subject at the end of 2012.

The graph and table below present data on pass percentage for learners in all schools that registered Physical sciences in 2012.

Table 4.2: Pass performance of 4084 learners who wrote Grade 12 Physical Science in 2012 in Tshwane District

Number of learners	4,084						
Levels	1	2	3	4	5	6	7
Pass %	0-29	30-39	40-49	50-59	60-69	70-79	80-100
School performance	830	907	575	545	577	505	724

Graph 4.2: Graphical representation of the pass performance of 4,084 learners who wrote Grade 12 Physical Science in 2012 in Tshwane South District



The total number of learners who registered for Physical Science at the end of Grade 12 in 2012 was 4,663. Of the total number of learners who wrote the final exam at the end of 2012, 830 failed the subject (0-29%) and 3,833 passed. The number of learners who passed Physical Science far exceeds the number of learners who failed. The number of learners who obtained university entrance (60% and above) was 1,806, which is more than of the total number of learners who failed the subject. This performance was good; therefore the researcher concludes that the status of teacher quality of Physical Science teachers in Tshwane South district was also good.

Township schools, city independent schools and former model C schools that got an average pass percentage of less than 60% in the previous year wrote common district standardised tests which were set by subject facilitators, as well as common provincial June and trial examinations in Grade 12 as a recommendation by the provincial MEC for Education to improve performance in the subject. The aim for this practice was to ensure standardisation of formal tests and examinations prior to the final examination for these schools and allow teachers to measure their teaching practices and their learners' performance against other teachers and learners in these categories of schools. Other schools whose performance was satisfactory chose to write common formal tests and the June examinations or set their own teats which were pre-moderated by the subject facilitator. All schools wrote the trial examination, except some excellent performing schools which had been exempted by the GDE (Subject Assessment Guideline, 2008: 4).

The researcher only used township and city independent schools for the study because of comparable factors at these schools in terms of learner enrolment, namely only black learners, mostly from the same socio-economic background, who all write district and common tasks and tests. Their teachers had almost the same tertiary educational background. The researcher obtained the 2013 term 1 formal test pass percentage record from the sampled schools at the beginning of term 2 and compared the results with the final 2012 results, in an attempt to establish the sustainability of performance at these schools, and so reinforce data on the status of teachers' quality in the district. The following data was collected:

Table 4.3: Pass percentages of the Grade 12 final examination in 2012 and term 01 2013 test for seven sampled schools in Tshwane South District

Type of school	**Pass percentage of final Grade 12 results**	**Pass percentage of control test 01 in 2013 term 01**	**% failed the control test 2013 term 01**
Level 01	15.38	60	40
Level 02	33.85	75	25
Level 03	40.00	67	33
Level 04	57.14	70	30
Level 05	68.75	85,3	15.7
Level 06	78.79	68	32
Level 07	83.08	82	18

The six examinable knowledge areas in Grade 12 Physical Science curriculum are Matter and Materials; Chemical Systems; Chemical Change; Mechanics; Waves, Sound and Light; and Electricity and magnetism (Learning Programme Guideline, 2008:8). According to the Examination guideline for Physical Science, the term 01 workload includes Mechanics (Vertical Projectiles, Momentum and Impulse, Work; Energy and Power), which constitutes ± 33% of the Physics (Paper 01) final examination; Matter and Materials knowledge area comprising Organic Molecules, which constituted ± 50% of Chemistry (Paper 02); and Optical Phenomena and Properties of Matter, which constituted ±15% of Paper 01 (Physical Science Examination guideline, 2009:21).

The overall amount of examinable paper 01 work to be covered in term 01 only is ± 65% of all examinable work and that for paper 02 is ± 33%, which is much examinable work that requires thorough teaching and assessment if learners are to do well in the final examination. Data collected showed an acceptable performance of all sampled schools, except for the level 1 school, which gave

learners a control test on Mechanics knowledge area only in term 01. Their results could not be acceptable as a true reflection of all examinable work for term 01. All other schools performed at above 60 with all term 01 content covered, which then reflected satisfactory quality teaching by teachers.

The data presented concurred with past research that showed that quality of teachers reflects the quality of the performance of learners. Although the researcher used the 2012 final results for the Grade 12 learners and the term 01 tests results for 2013 to draw conclusions on the status of teacher quality in Tshwane South district, it was acknowledged that there were many contributing factor directly or indirectly related to the teaching practices, which influence the performance of Physical Science. The researcher obtained data on these factors based on previous studies and analysed the findings to establish the impact that they had on the performance of Physical Science in the district, hence an attempt to address the second secondary question.

4.3 FACTORS RELATED TO TEACHING

In an attempt to answer the secondary question, *to what extent do factors related to teacher quality in Tshwane South district affect the performance of Physical Science?* the researcher analysed available data in terms of factors directly related to actual teaching practice, that is what and how the teacher teaches, those that are indirectly related to teaching, and those that depends on the teachers' decision to enhance his/her quality of teaching. The researcher collected and analysed available data on teacher profile, teachers' responses to the questionnaire, classroom observation, document analysis of learners' written tasks and interview questions.

4.3.1 Factors directly related to teaching

For this study, factors identified as directly related to teaching were as follows.

4.3.1.1 Teachers' qualifications

The researcher collected raw data on teachers' qualifications obtained from 56 teachers in 43 of the 78 schools that offered Physical Science in 2012 in the district as representation of teachers teaching Physical Science in Tshwane South

district. Data was collected to establish if Physical Science teachers had a teaching qualification and also if they had specialised in Physical Science in their qualifications. Teaching qualifications provided an indication on whether practising Physical Science teachers in the district had the required pedagogical content knowledge to teach Grade 12 Physical Science learners and qualifications in Physical Science teaching provided an indication on whether practising teachers had sufficient content knowledge to teach it to the Grade 12 learners. In addition, qualifications were used to establish whether they had an influence on the teaching practices of the teachers, and consequently the performance of learners in the grade 12 final examinations.

The table below summarises the analysed data.

Table 4.4: Summary of teachers' qualifications in 43/78 schools in Tshwane South District that offered Physical Sciences in 2013

Qualification	**0-1 years specialisation in Physics/Chemistry /Physical Sciences**	**2-4 years specialisation in Physics/Chemistry /Physical Sciences**	**5 years and above specialisation in Physics/Chemistry /Physical Sciences**	**Non-professional teaching qualification**
N6	2			2/2
STD /FED/UDE(s)	1 (not a secondary school qualification)	14 (04 have 2 year,10 have 3 years)		
BED/BSC/STD/ FED/UDES + ACE		19 (8 have 3 yers,11 have 4 years)		
BED/BSC/STD/ FED/UDES + ACE + Honours		16	2	8/18
MED/MSC			2	

The data collected indicated that only two practicing teachers were under-qualified, eight had Bachelor of Science degrees, indicating acceptable content knowledge, but were not qualified professional teachers, which might contribute to possible challenges in pedagogical content knowledge. Data on specialisation in Physical Science, Physics or Chemistry indicated that of the 56 teachers from whom data was collected, three were not qualified to teach Grade 12 Physical Science learners because one had a primary teacher's diploma and two had taken N6 courses in Mechanics. Four teachers had taken Physical Science up to second year at tertiary level and 18 had a three-year teaching diploma from teacher colleges prior to 1994. The other 20 had a four-year qualification or above in the subject.

Of all data collected, 53 of 56 Grade 12 teachers from 43 of 78 schools that offered Physical Science in 2013 were qualified to teach Physical Science in Grade 12 and 45 of these were professional teachers. This data indicated that 53 of 56 teachers had sufficient content knowledge and 45 of 56 teachers had sufficient pedagogical content knowledge to teach Grade 12 Physcal Science learners in 43 of the 78 schools that offered Physical Science in 2013 in the district. Data collected indicated overall satisfactory qualifications of teachers in the district, which if related to the overall results at the end of 2012 explained the overall high pass percentage and the high number of university entrances in Physical Science in Tshwane South district.

From the questionnaires given to sampled teachers the researcher established that the level 1 teacher was not qualified as a teacher nor in Physical Science. One level 2 teacher, the level 3 teacher and the level 5 teacher had a three-year teaching diploma in which they both specialised in Physical Science. Another level 2 teacher and level 6 teacher had a four-year teaching diploma with specialisation in Physical Science. A level 4 teacher had a three-year teaching diploma with specialisation in Physical Science, an ACE cerificate and an honours degree both with specialisation in Education Management. The level 7 teacher had a three-year teaching diploma with specialisation in Physical Science, an ACE certificate in Physical Science, and an honours degree with specialisation in Natural Sciences.

In South Africa, it is acceptable for teachers to teach a content subject if they have taken it up to the second year of tertiary education (DoE, 2000). Based on this criterion and looking at the perfomance of Tshwane South schools in the 2012 final examination examination, the data indicated that the overall satisfactory perfomance of the district in Physical Science was a result of most teachers in Tshwane South district meeting the criterion set by the DoE to teach a content subject. The overall Physical Science teacher quality in Tshwane South district was of acceptable level, hence the overall good perfomance (79.6% in 2012). Data also indicated that seven of the eight sampled teachers were professionally qualified to teach Grade 12 Physcal Science.

In response to a question on whether teachers thought that qualifications were determinants of good Physical Science teaching, all sampled teachers responded with a "*yes*", meaning that most understand the importance of proper qualifications in teaching a content subject such as Physical Science.

In response to interview questions to establish if the level 1 teachers' underqualifications of N6, an 18 months course in one part of Physical Science instead of a three or four-year qualification, impacted on his perfomance in the subject, he responded by saying: "*The Physics part is not much of a problem because in the N6 course, there was some Physics although I can see there are new chapters like Doppler effect, Photo-electric effect and Work - Energy theorem which I don't remember doing at school or at the college. For me to teach these topics, I have to study them first".*

The response of this teacher indicates that he understood that qualifications affect the performance of a teacher otherwise lack of qualifications means that the teacher is not able to teach some content that he did not study, therefore he has to study most of the content before teaching it. Understanding the concept in question is also questionable if studying is not supplemented by a tutor or a mentor.

4.3.1.2 Teachers continuous professional development through upgrading

Higher education institutions introduced the ACE and NPDE courses after 1994 as a means to increase qualifications in addition to other courses that had been run

at tertiary institutions. The ACE course in particular was meant to improve the Physical Science and Mathematics qualifications for unqualified and under-qualified teachers, although other major courses, such as Education Management, were also part of the choice. According to past research, most Physical Science teachers do not take advantage of this opportunity and most of those who do choose to specialise in Education Management rather than Physical Science content. Of the sampled teachers for this study only the level 7 teacher did an ACE course with specialisation in Physical Science, and still pursuing further studies in Physical Science with consistently good results.

The level 4 teacher studied the ACE course but majored in Education Management and her results were below 60%. The performance of these two teachers confirms the statement by Parker (2011) that advanced qualifications can improve the performance if specialisation was in the subject taught. The rest of the teachers, except the level 1 teacher, who was unqualified, have since qualified and not pursued any further studies in the subject. However, when asked in the questionnaire if they thought that increasing qualifications can increase the performance of a teacher, all teachers agreed that it would. Campbell et al. (2004) indicated that teachers were expected to meet high standards of teaching and raise levels of achievement in schools since teaching today takes place in a world of rapid change and development. The responses of the sampled teachers indicated that all teachers attributed good perfomance in Physical Sciences to proper specialisation in qualifications. The researcher views increased qualifications to be effective when coupled with other factors directly related to teaching, which explain the outstanding performance of the level 7 teacher, and also the good performance of the level 5 and six teachers.

4.3.1.3 Teachers continuing professional development through workshops

South Africa's changing curriculum as well as the DoE's effort to close the content gaps acquired by teachers in the country, and the difference in the quality of tertiary education obtained by teachers in the past, requires Physical Science teachers to attend content and pedagogical workshops in order to be in touch with current trends in the subject. The Teacher Professional Model (2003) indicates that continuing professional development allows teachers to expand and deepen

their teaching. Lessing and De Witt (2007) support this but add that these courses should be designed to provide avenues for teachers to refresh their knowledge, to improve their competencies and to bring about a paradigm shift in their outlook towards educational issues.

The researcher had used a record of attendance of workshops which were only facilitated by the subject facilitator, who happened to be the researcher in this case, for the previous three years. Attendance at these workshops by teachers was used by the researcher to establish if Tshwane South Physical Science teachers attended these workshops and to compare attendance with the overall perfomance of schools in the district and specific perfomance of all sampled schools, then compare these with the 2012 results. The aim was to establish if workshops had an influence on the perfomance of the Physical Science in the district. The researcher based the results on between 50% and 100% attendance at content and pedagogical content knowledge workshops.

From 2010 to 2012, the researcher as a subject facilitator held five content and pedagogical content knowledge workshops for Grade 12 teachers each year, which implies that from 2010 to 2012 teachers had been given 15 workshops.The first given to teachers each year included a report back from external Grade 12 exeminers and moderators as well as discussions on the pass percentages in the final examinations. The researcher, together with teachers, discussed difficult content, common mistakes made by learners in the examinations, misconceptions and misunderstandings of contents and concepts, in order to equip teachers on teaching and assessment practices of these topics and allow excellently performing schools to share good practices with those that were underperforming. The remaining four workshops included information sharing on challenging content that carried more marks in the final examination in which most learners did not perfom well and practical tasks in those topics for schools that had performed below 60% in previous years, plus new Physical Science teachers in Grade 12.

The topics discussed in the previous three years were based on external reports by examiners and moderators on the final examination from 2010 to 2012 on Mechanics, with more emphasis on Work; Energy and Power, Organic Molecules, with more emphasis on using flow diagrams to answer questions on chemical

reactions; Chemical Change, with emphasis on calculations of equilibrium constant and intepretation of equilibrium graphs; and Electric Circuits, because this topic was taught in Grade 11 but assessed at a higher level in Grade 12. The other topics, which were not very challenging but which teachers wished to discuss, were handled at support group meetings as the teachers' own initiatives.

Township schools, city independent schools, underperforming former model C and new Grade 12 teachers were encouraged to attend all workshops as far as possible so that they could refine their teaching practices each year and also because some schools practiced the rotation method, whereby the Grade 12 teacher in one year might not be the same as for the preceding years, so all teachers required some development and support. Former good performing model C school teachers had an option to attend these workshops. The researcher encouraged these schools to utilise support group meetings to discuss any challenges they encountered to give more attention to other schools and so improve on poor perfomance and sustain good perfomance. However, former model C good performing schools could invite the subject facilitator to their meetings if they needed intervention.

The table below records workshop attendance by 56 Grade 12 teachers in the district, including those from the sampled schools, as well as a breakdown of attendance of sampled teachers over the three years.The researcher collected data from 56 teachers in 43 of the 78 schools because of a belief that data from eight teachers from the seven sampled schools would not prove reliable data in drawing conclussions on workshop attendance for all 78 schools that offered Grade 12 Physical Science in Tshwane South district in 2012.

Table 4.5: Summary of workshop attendance by 56 teachers in 43 of the 78 schools in Tshwane South District for the previous three years

Teachers who atteded	**Total attendance at workshop for 2010**	**Total attendance at workshop for 2011**	**Total attendance at workshop for 2012**
56 teachers in 43/78 schools including sampled teachers	39 teachers	34 teachers	48 teachers
Attendance of sampled teachers over the past three years			
Level 1	0	0	0
T1 Level 2	5	5	2
T2 Level 2	0	0	5
Level 3	4	4	4
Level 4	3	5	5
Level 5	2	5	5
Level 6	4	5	5
Level 7	5	5	4

Data on workshop attendance from the 56 teachers in 43 of the 78 schools, which included sampled teachers, was collected first, followed by data of sampled teachers. The results showed an improvement in attendance from 2011 to 2012, with all schools that had been offering Physical Science recording more than 50% attendance by teachers at workshops. This satisfactory attendance was viewed by the researcher as a contributory factor to the quality of teaching and the quality of the district results from 2011 (72,84%) to 2012 (79,67%), since this refined and added to teachers' existing knowledge. Data from sampled schools revealed that the poorest performing school had a 0% attendance at workshops, and teachers from satisfactory to excellent schools had attended the most workshops.

In response to questionnaires for sampled teachers on whether workshop attendance had improved their expertise in teaching of Physical Science, three of eight indicated that it had not, while five of eight of the sampled responses agreed that workshop attendance could improve the expertise of teaching.

The effect of the attendance of workshops on the performance of Physical Science was also collected through interviews with two sampled teachers after

classroom visits. The response of a level 5 teacher whose ACE qualification was not Physical Science orientated was: "*I am an HoD and a possible Deputy Principal at my school since I am acting in the position. I do attend any content and methodology workshop that is available for Physical Science, so I think the information from these is sufficient to help me with the subject".*

The following response by the level 5 teachers reinforced the importance of attendance at workshops: "*I make sure that I attend any Physical Science workshop available, use as many resources to prepare for my lessons and I ask for help when I need it".*

The responses of these two teachers indicate that teachers viewed workshop attendance as a contributory factor to improving Physical Science performance.

4.3.1.4 Teacher induction

Data collected from eight sampled teachers to establish if teacher induction offered enough preparation for them to produce satisfactory Physical Science results in Grade 12 revealed that only the level 7 teacher had been inducted when he started teaching. The rest did not receive any induction at their schools. This teacher was still the one who has consistently produced excellent results. The conclusion made by the researcher on this data was that good induction programmes prepare a teacher for his/her work and have a long-term impact on work performance. In response to a question on whether they thought that inducted teachers became better Physical Science teachers, the level 1, 2 and 6 teachers disagreed. However the remaining five teachers of the sample indicated that teacher induction could improve performance.

The researcher asked some questions related to teacher induction to the level 1 and level 2 teachers. Both these teachers had indicated in the questionnaire that they did not think that teacher induction could improve performance, however in response to challenges that they faced at their schools on lack of support from the school managers the researcher made assumptions that an induction course could have been helpful. The level 1 teacher did not have any support structure to help him develop in his teaching practice. When asked how he was going to

correct misconceptions taught he indicated that he did not know anyone and did not have an HoD.

One level 2 teacher had been taken in and out of Grade 12 Physical Science teaching, instead of being properly developed to improve. His response to why he did not produce desired results was: *"Last year I was removed from teaching Grade Twelve because in 2011, I did not produce good results so those results are not mine; however the 2010 results were also not good and frustrated me"*.

Instead of offering the level 2 teacher support when his results were unsatisfactory the school managers simply removed him from teaching Grade 12. The responses of the level 1 and 2 teachers indicated a contradiction on their responses to the questionnaire and during the interviews regarding the importance of induction; otherwise it implied that they did not understand what it meant to be inducted. The level 7 teacher, as the only one to be inducted in the teaching system, had been teaching Grade 12 Physical Science at the same school over the previous three years and had produced over 80% each year - 89, 80% in 2010; 88, 89% in 2011 and 83, 08 in 2012.

4.3.1.5 Teachers' knowledge (content and pedagogical content knowledge)

In order to collect sufficient data on teachers' knowledge, the researcher collected it from questionnairres and conducted classroom observations during actual teaching, to observe if teachers had sufficient knowledge to teach Grade 12 Physical Science. During classroom observations, the researcher used the lesson observation templates to record data on the correct language of instruction during teaching. Teachers' confidence during teaching time, wherein moving about in class to attract learners attention and showing confidence by not displaying weaknesses obvious to learners, was observed, as well as sufficiency of content knowledge required for the topic, pedagogical content knowledge for the topic (teaching methodologies), discipline and participation of learners.

The researcher considered actual classroom practice as providing a clearer perspective of the quality of teaching that learners received every day and how this affected performance at the end of the year. Classroom observations were made for Grade 12 teachers in 2013 for sampled schools and compared to the

final 2012 results. The researcher took into account that teachers could give ideal lessons for the day of the visit because they were expecting the researcher to come to their school.

In response to whether sampled teachers had enough content and pedagogical knowledge to teach Grade 12 Physical Science, all except the level 1 teacher indicated that they did. The level 1 teacher had produced the lowest results and skipped Chemistry content in term 01 of 2013. When the researcher related the specialisation of the teachers in Physical Science as a measure of content knowledge and the teaching profession as a measure of pedagogical knowledge, data presented on the qualifications of seven of eight sampled teachers in Physical Science indicated that the lowest qualifications in the subject (level 1 teacher) resulted in the poorest performance, while the highest qualification in the subject (level 7 teacher) resulted in excellent performance.

Physical Science is taught and assessed both internally and externally in English, and it becomes effective for teachers to teach and assess learners in English internally. Code switching poses a challenge because there are ten other official languages, in most of which teachers are not usually fluent. In most cases teachers switch to their mother tongue, which is not necessarily every learner's, and this can create even greater misunderstanding and misconception since one word may have different meanings. One level 2 teacher did not use code switching during teaching but made many errors when speaking in English, resulting in loss of meaning. In one instance a learner corrected the teacher's language use during the lesson, which embarrassed her. This could have been because the teacher switched when the researcher was not at the school, because continuous use of a language improves ones' proficiency in speaking that language. Wrong use of the English language makes learners lose focus on the content taught. The researcher observed during this lesson that only two learners out of a total of 38 in class on that day attempted all questions asked, while others sat passively.

The level 4 teacher switched several times to Northern Sotho to try and explain some concepts. According to the researcher, this did not help all learners to understand because after the explanation, when the researcher confronted two who seemed confused by the teacher's attempt to clarify the concept in question,

she discovered that both learners were Zulu-speaking and still did not understand her explanation. In South African schools, the range of African languages in one class is wide and one cannot assume that explanation in one of these languages will benefit all learners. Wrong language usage during teaching can result in wrong interpretation of questions by learners in the assessment activities, because when they write formal tests and examinations the teacher is not there to interpret the questions.

The levels one, three, five, six and seven teachers were also Sotho-speaking but in their lessons they only taught in English. The level 3 and five teachers had acceptable participation and the level 6 and seven teachers had maximum participation by learners, all using English to teach and assess learners. Data collected indicated that correct use of the language of instruction improved understanding of assessment activities, which helped learners to understand examination questions.

The level 1 and all level 2 teachers did not move around the class as they taught. The level 4 teacher moved in front of the class from one corner to another, looking at all learners but did not walk in rows between them. The levels 3, 5, 6 and 7 teachers looked very confident and moved about in class throughout the lesson. The level 6 and 7 teachers also asked questions to learners who did not raise hands as they moved about in class. Data collected indicated that three of the eight sampled teachers did not display enough confidence in class, while five of the eight did.

The level 1 teacher stammered while talking and in most cases learners would giggle because he repeated some words. Both level 2 teachers had low toned voices that they could not increase enough for all learners to hear first time. The one level 2 teacher’s voice was trembling as if she was nervous or not sure what she was saying. A learner asked this teacher a question that she could not answer because the content was from the same topic that was taught but the information required in particular was beyond the Grade 12 syllabus. The teacher could not answer the question and instead of indicating to the learner that she would do some research, she attempted several times to answer the question without any success, which portrayed her as not knowing Physical Sciences. During the

lessons for the level 1 and the other level 2 teachers, learners did not show willingness to participate in class, which did not result in impressive lessons for them. The level 1 teacher and one level 2 teacher also predominantly referred to textbooks while teaching, which displayed none or poor preparation or insufficient content knowledge.

The researcher related lack of confidence in the level 1 teacher to insufficient content knowledge, amongst other factors. He looked uncomfortable during his lesson presentation. His response to a question on his view on his limited content knowledge on his performance was: "*There are many things that I have to study before teaching, sometimes I think learners can see that I don't know*". This response indicated that the teacher was aware that he did not display appropriate confidence in class**.**

Misconceptions, incorrect explanation of concepts and incorrect marking is an indication that the teacher was either unsure of the content taught or did not understand it. Evidence of incorrect explanation of concepts during teaching was observed with the level 1 teacher, as in his response to the questionnaire he indicated that he did not have sufficient knowledge to teach Grade 12 Physical Science learners. The researcher was satisfied with the content taught by the level 2 to level 7 teachers.

When the level 1 teacher was confronted with an incorrect explanation of concepts during an interview after the classroom visit, his answer did not provide any solution. This explained learners' performance in this school because in the final examination incorrect answers are not marked correct. His response was: ***"I don't know anyone around here, I only came to teach at this school towards the end of February and I don't have an HoD".***

The researcher collected data on teaching methodologies to establish how teachers used pedagogical knowledge to deliver lessons. This included the use of various available resources, content coverage using the work schedule and inclusion of learners with barriers, not necessarily handicapped but having difficulties such as in understanding, hearing, talking or seeing. The data was

collected in order to establish if teachers could present an effective lesson amidst some unavoidable challenges.

One teacher each from level 2, level 3 and level 7 incorporated the traditional teaching method of using a chalkboard with an e-lesson, whereby simulations that would not be shown on a chalkboard were shown to learners. They also allowed learners to engage in discussions. The level 03 teacher had a performance below 60% but had been showing improvement from 32% in 2011 to 40% in 2012, implying an increase in teacher quality. The level 2 teachers did not produce good results but still used e-lessons in their teaching. The level 4 and level 5 teachers had laptops given to schools to help them with Physical Sciences teaching but did not use e-lessons; however the level 5 teacher performed sufficient practical demonstrations and allowed learners to conduct several informal experiments.

The researcher observed that learner involvement for three of the eight teachers who used resources teachers was better, whereas for the level 2 teachers participation by learners was minimal since the teacher predominantly assimilated information and rarely engaged them. The level 4 teacher did not use e-lessons even though she indicated that the school had such resources. The researcher observed that the levels 5, 6, and 7 teachers gave some attention to slower learners. Data collected indicted that the incorporation of all good teaching methodologies resulted in interesting, effective lessons.

The researcher did not observe the use of an e-lesson with the level 6 teachers but learnt during an interview that the teacher also used such lessons. The level 6 teacher responded as follows regarding his teaching methodologies:

“I structure my methodologies to the need of the lesson, starting from the old ways of teaching, performing practical activities and showing Science clips when they are needed. It depends on the nature of my lesson. But most of all I plan for my lessons well as assessment activities for each lesson”.

The level 3 teacher responded to a question on whether e-lessons were effective or not as follows: “*…there are learners who understand better when they see things, for example if you speak about movement of molecules; it can only better*

be understood by learners if you show a simulations. E-lessons also saves a lot of time, you teach more content in a period that talking".

A well-disciplined class allows the teacher to cover more work during a period because no time is lost by learners misbehaving and teachers addressing disciplinary issues at the expense of contact time. One of the roles of teachers, according to the South African Schools Act (SASA, 1996) is to offer a pastoral role (DoE, 1996). The researcher collected data from classroom observations and interviews with teachers to attempt to establish how classroom management affected actual teaching practices.

Learners did not seem to take the level 1 teacher very seriously, at one point in class talking to each other without being instructed to do so, and it was not easy for him to reprimand them. During oral assessment, when learners got the answer wrong the teacher did not allow time for discussion or a chance for other learners to answer, but simply gave the correct answer and moved on.

The level 4 teacher engaged learners in the lesson, continually asking questions and allowing for discussion, but because there were no rules to control noise levels, learners made noise. When the level 4 teacher asked questions, learners would answer, many at a time, and the discussions were noisy. The teacher did not move around during the lesson to try and encourage learners to keep the noise level low, moving in front and managing groups from the front.

Observations made during classroom observation with the levels three, five, six and seven teachers were that they had ground rules pertaining to the manner in which learners should conduct themselves in class. These rules were either displayed in class, when all learners could read them for levels five, six and seven teachers, pasted in their classwork books for the level 3 teacher. These rules included all or some of the following: conduct when the teacher asks a question in class; conduct when one learner gives a wrong answer and when other learners have an alternative answer; proper dress code for class and for conducting experiments; rules of arriving, sitting and departing from the class; the appearance of books as well as of written work; and rules of engaging in discussions and experimental work, which included minimal noise and allowing maximum

participation by all group members. During oral assessment, learners quietly raised their hands and waited to be selected by the teacher. If the answer was wrong, others raised hands again to give the correct answer.

The level 7 teacher mostly allowed learners to correct each other in an orderly manner. The two level 2 teachers did not have any rules displayed nor did they have significant classroom management challenges. Of the sampled teachers, six of eight of did not have classroom management challenges and of the six, four delivered interesting lessons with maximum learner participation.

The level 4 teachers had challenges with classroom management, a question that was meant to arouse the interest of learners and encourage them to debate issues, led to a noisy class that the teacher could not control. In one of the interview questions after classroom observations on the conduct of some learners during class and the impact the noise made on their performance, her response was: "*I have very naughty learners and you know we should not use corporal punishment, so sometimes I don't know what to do*".

Contrary to that, the response of the level seven teacher was: "*Classroom management is the core of an effective lesson. I have set rules that learners are aware of as well as the punishment that goes with not doing the right things, however I like to use reward more for good behaviour instead of punishment. There is a point system where points are added or deducted for good and bad behaviour. I have also committed to playing more of a parental, pastoral role and a mentor to these learners so that they can want to behave well. If the learners know that you have an interest in their lives as well besides their performance, they never want to let you down".*

Data collected from interviews indicated that teachers understand that classroom management plays an important role during teaching.

4.3.1.6 ***Teacher competence***

The characteristic of competence is fundamental to a teacher's pursuit of excellence (Vallicelli; 2012). Competent teachers try to ensure that all information required for learners to get excellent results is provided to them on time, hence

competence reflects teacher quality. According to data required for this study, the researcher used the quantity (number) and quality (inclusion of all examinable content and all cognitive levels) in all written tasks (classwork, homework, and informal tests), and formal practical tasks to rate teachers competence.

To measure if the teacher had provided an acceptable quantity of written tasks, the researcher checked the number of learners' tasks against the work schedule, and to see if all knowledge areas, topics and sub-topics expected to be covered in the first term of 2013 had been assessed. In Physical Science, teachers were required to give daily assessment (Subject Assessment Guideline, 2008:7). The 2013 term one lasted 11 weeks, which is nine full weeks, as well as one with three days and one with four days, making a total of 52 contact days. When using the number of full weeks only, Grade 12 Physical Science teachers should have given a minimum of 24 and a maximum of 40 informal written tasks comprising classwork, homework, informal tests and informal practical tasks, in order to leave some time for preparation and writing the formal test and formal practical investigation.

The researcher checked if learners had been given at least three written tasks per week, in order to establish if all examinable work had been assessed informally before it could be assessed formally. In addition to informal activities, teachers should have controlled at least 10% of learners' tasks, and corrections for all wrong work should have been made. In term 01 of 2013 the researcher could not conduct classroom visits nor ask for learners' books due to the disengagement of the major teachers' union, to which six of the sampled schools had teachers affiliated. Due to the sensitivity of the situation the researcher collected data on written tasks at the beginning of term 02.

At the beginning of term 02, when the researcher visited schools to conduct the study, the record of informal written tasks for the sampled schools were: 12 for the level 1 teacher, 22 for the level 2 teacher, 16 for the level 3 teacher, 18 for level 4 teacher, 22 for level 5 teacher, 25 for level 6 teacher and 28 for level 7 teacher. Insufficient written tasks indicated an omission of certain topics or sub-topics for assessment, a practice that can lead to underperformance. All assessment tasks for level 1 were from the same knowledge area-Mechanics. The level 3 and level 4

teachers had covered all of term 01 content but excluded some sup-topics. Levels 2, 5, 6 and 7 had covered all topics and sup-topic in all knowledge areas required for term 01, 2013.

To measure the quality of written tasks, the researcher included all examinable types of questions and cognitive levels. The types of question, as in the external examinations, were: one word, multiple choice, definitions, explanations, laws, principles, questions based on practical tasks, questions based on the application of Physical Sciences, drawing and interpretation of graphs and moderate to difficult calculations. The cognitive levels include recall questions (level 1), comprehension (level 2), application and analysis (level 3) and evaluation and synthesis (level 4) (Subject Assessment Guideline, 2008:9), participation of learners 15).

Data collected indicated insufficient quality in written informal assessment tasks by sampled teachers except the levels 6 and 7 teachers, since these were the only teachers who covered all cognitive levels in their informal tasks and all types of examinable work.

Some examinable types of question were not addressed in informal activities by the level 1 to level 4 teachers. The level 1 teacher only assessed low to moderate questions and did not even seem to be aware that other types of questions needed to be assessed. His response to a question on cognitive levels was: *I also don't know what you mean by level 01 and 02 questions? I use exercises that are in the textbook*.

The levels 2, 3 and 4 teachers made assumptions about what learners knew and omitted types of questions that could boost their performance, for example, the Section A questions, definition, explanation and higher order questions such as evaluation and creating. The level 2 teacher's response to an interview question on the inclusion of all types of questions was: *"I try to give more problem solving activities because these are very difficult. The other questions that you mentioned are easy and these learners can pass them by studying them on their own. I have given them past exam question papers".*

This practice could have affected the quality of results for the level 2 teacher, since he had given sufficient work, but it did not adequately prepare learners to answer all questions in the examination, hence his performance of below the 60% benchmark.

The response of level 7 teachers to a question involving types of questions was*: I teach every examinable content in Grade Twelve even though I have taught it in the lower classes, and raise the assessment standard to suit the final Grade Twelve exams. I ensure that I assess all types of examinable questions and all levels of questions first in the classwork's, homework's, informal test then in the formal tests. I give informal test for all work covered in a week every Friday if we have a full week. In these tests, if any learner gets less than fifty per cent they have to rewrite the test again until they get sixty per cent, so this is a form of revision for them plus they study for the test because they don't want to remain after school to rewrite the tests.*

Data on the quality and quantity of written tasks indicated good performance by teachers who complied with the required assessment practice.

In the first term, Grade 12 learners had to make one formal practical investigation as part of the 25% SBA marks (Gauteng School Based Assessment Guideline Document 2009 – 2012:3). Completion and compliance (correct report write-up) of practical tasks by learners plus fair, reliable and consistent marking of the practical tasks by teachers can either advantage or disadvantage learners in the final year examinations, since the skill to answer practical task questions are still assessed in the final examinations. In addition, if learners have not done practical tasks their results can be withheld (National Protocol for Assessment Gr R-12: 11-12). This task was moderated at the beginning of term 02 by appointed teacher moderators (Gauteng Physical Science edited SBA Guideline 2013:14-16). It was based on the compliance of the practical investigation in terms of coverage of all cognitive levels, the quality of marking by teachers and quality of internal moderation by school HODs.

The researcher considered that the final examination questions should include questions based on a practical investigation, hence the importance of assessing

these correctly. Non execution of task, especially one that is examinable in the final examination was viewed by the researcher as being unable to do the task or unwilling to do the task. According to the definition of a competence, a competent teacher is one who will ensure that learners are given all chances to perform better. Based on this argument, the researcher categorised teachers who did not provide necessary skills to answer examinable type questions from a practical investigation as incompetent. These are teachers who did not perform the task with learners and had not ensured that all practical examinable work was effectively taught.

Tshwane South district township and city independent schools wrote common practical tasks for both terms. The researcher sampled learners' tasks from participating schools for this study. Since the quality of the tasks had already been pre-moderated, the researcher only used the quality of marking by teachers to make conclusions on their competence, because if the teacher were competent in teaching Physical Science they would give all required assessment tasks and assess them well, in order to fully prepare them for external assessment through examinations. Only the level 01 teacher had not done the term 01 practical tasks at the time of data collection for the second time at the beginning of term 3. The results of the practical investigation was coded as 0 for task not done, 1 for poor, 2 for acceptable practice, and 3 for satisfactory practice, and reasons were given for the ratings awarded.

The following table summarise the researchers' findings:

Table 4.6: School Based Assessment (SBA) tasks report for sampled schools

Type of school	Quality of marking the practical investigation	Reason for rating
Level 1	0	The term 01 practical task had not yet done at beginning of term 02
Level 2	1	Lenient marking, marks overrated when not deserved, e.g., the interpretation of results and conclusion for most learners were marked the same, even if facts were interchanged between the two sup-topics, indicating a misunderstanding by teacher. This indicated to the researcher that the teacher could not differentiate between the two and had not given proper guidance to learners.
Level 3	1	Lenient and seldom wrong marking, many discrepancies discovered after moderation. The teacher used a memorandum whose marks matched the rubric ratings but in most cases the mark awarded in the memo would be less than that awarded in the rubric. One of the responses required learners to identify the variables in the practical investigation. The learner got 2/3 answer correct, but the teacher awarded three marks.
Level 4	2	Some inconsistencies were observed, e.g., one answer would be marked wrong for one learner but a similar response would be marked correct for another learner. Sometimes the teacher awarded different marks for the same responses by different learners.
Level 5	2	The teacher did not explain to learners that even if they performed the practical investigation together in groups, each learner had to write their own report. Learners from the same group wrote the same report and the teacher accepted this, meaning that it was his instruction. Such practice denies a poor performing learner a chance to be helped because all results look the same.
Level 6	3	The marking practice was satisfactory in terms of correct marking and feedback given to learners so as to provide guidance to learners for future reference.
Level 7	3	The marking practice was satisfactory in terms of correct marking and feedback given to learners when marking so as to provide guidance to learners for future reference.

Data collected showed non-execution of the tasks by the level 1 teacher, a factor that could cause learners not to be given a result at the end of the year. In the final year examinations, in both papers of Physical Science, there are questions based on a practical investigation which require learners to implement the skills taught to perform a practical investigation and so answer questions from a practical task. If these skills are not taught or have been poorly taught, it is probable that learners will not be able to do well in these questions and may perform poorly. Incorrect and inconsistent marking can make learners revise incorrect answers. In preparation for the final examination, they tend to revise work that they perform well in, so if teachers awarded undeserved high marks for practical tasks the learners would not revise what they should have, because it was marked correct.

Data indicated satisfactory compliance of practical tasks by the level 6 and 7 teachers, the two best performing ones, and the worst performance by the level 1 followed by levels 2 and 3 teachers.

4.3.1.7 Grade 12 teaching experience

The researcher collected data on Grade 12 teaching experience from sampled teachers in order to determine if teaching experience had any influence on the quality of teaching and how it could affect the performance of Physical Science. The researcher established that the level 1 teacher and one level 2 teacher had less than three years' teaching experience, another level 2 and 3 teacher had between 3 to 5 years Grade 12 interrupted teaching experience, level 4 had between five and 10 years uninterrupted teaching experience years whilst levels 5 to 7 teachers all had more than 10 years of uninterrupted Grade 12 teaching experience respectively.

Table 4.7: Grade 12 teaching experience for sampled teachers

Experience in teaching Grade 12 Physical Sciences	0-2 years	3-5 years	5-10 years	10 years and above
Sampled teachers	L1,(T2) L2	(T1)L2,L3	L4	L5,L6, L7

All teachers indicated in the questionnaire that experience can improve the quality of teaching.

4.3.2 Factors indirectly related to teaching

The researcher categorised factors indirectly related to teaching as those involving teacher professionalism: professional values, professional conduct/ethics, teachers' behaviour, teacher attitudes, teacher motivation, interest and commitment, all to be investigated for purposes of this research. These factors are the teacher's decision to enhance his/her teaching practices.

4.3.2.1 Professional values, conduct and behaviour

Classroom observations did not reveal any unacceptable behaviour by any of the sampled teachers. The conduct, dress code and relationship of these teachers with other colleagues, as well as learners, were professionally acceptable.

Information received from principals on professional values, conduct and behaviour indicated that all sampled teachers had acceptable behaviour. All principals indicated during interview sessions that their teachers had acceptable professional conduct. The researcher could not use professional values, conduct or behaviour to argue how they affect the performance of Physical Science, since data collected was the same for all teachers, albeit their performances were different.

4.3.2.2 Teachers' attitudes

The researcher used document analysis and interview responses to collect data on the attitude of teachers towards Physical Science and towards learners taking Physical Science.

The level 1 teacher did not reflect a positive attitude to the subject or to the learners. His lack of competence in Chemistry resulted in him skipping the content and not asking for assistance from the subject facilitator or teachers from neighbouring schools. He should have administered the district control tests because his school had achieved less than 60% in the previous year. Content assessed should have covered questions from Mechanics (P1) and Matter and

Materials Paper 1 and 2. Instead, the researcher observed that he had set his own test out of the Mechanics topic only, wherein questions ranged from simple to moderate levels of difficulty. His lack of initiative in ensuring that practical tasks were completed and his inability to indicate this challenge to the subject facilitator on time added to the researchers' conclusion that his attitude to the subject was not positive.

The following responses of the level 1 teacher reinforced the researchers' conviction that he did not have the right attitude to teach Grade 12 Physical Science. When asked how he was going to ensure that all terms 01 and 02 practical tasks were done, he indicated that he did not know.

On being asked why he omitted the Chemistry content in term 01, he indicated that he would ask a teacher to help him. The researcher found the actions of the teacher and his response displayed a negative attitude to the subject. It should have been his initiative in the first term to get a teacher to help him, instead of still thinking about it in the second term. He also displayed a negative attitude to learners when asked if a buddy teacher could help with content that he struggled with: "*I think so but also these learners we are having, they are not serious about anything"*.

All other teachers had a positive attitude towards the subject and their learners. Although the level 2 to 4 teachers' results were below the provincial benchmark of 60% in 2012, their term 01 results showed an improvement of above 60%, considering that ± 47% of all examinable works is content taught in term 01 (Subject Assessment guideline, 2008). The level 2 teacher spent his money to increase his knowledge in the subject. All levels 3 to 7 teachers believed they would improve performance because of the effort they put in the subject. When asked if a performance of 60% was possible, the levels 3 and 4 teachers indicated that they would meet the target. They responded this way to interview questions:

Level 3 teacher: "*I have all the resources I need, I have extra classes with learners and I comply in as much as I can".*

Level 4 teacher: "*I have extra classes twice a week for all learners and we are also on target with SBA tasks, so yes I'm coming out, never to return".*

The level 7 teacher still hoped for excellent results, despite other learners at his school only having started taking Physical Science in the second term.

Responses from other interview questions on the following questions and the responses of sampled teachers were:

Do you regard attitude as a factor that can affect learners' performance of Physical Science in Grade?

The response of six of the eight sampled teachers was a "*Yes*" while two level 2 and 3 responded with a "*No*". However in response to the question**:**

How do you describe your attitude and its impact on the Grade 12 Physical Science?

All teachers responded that they had the right attitude to produce satisfactory result in Physical Science. Data collected and analysed on attitudes resulted in the researcher concluding that the attitude of the teachers in the subject was reflected by his teaching and assessment practices and not their own perception only.

4.3.2.3 Teachers' motivation

Data collected from interview questions after classroom observations revealed that levels 1 to 4 teachers had something that demotivated them. The level 1 teacher was affected by his principal's apparent lack of commitment to helping him in getting the help and resources he needed to teach the subject effectively. Another de-motivating factor could have been that he had not been paid for two months, and he did not hope for an improvement in the results. This was his response during the interview on whether he saw the 60% benchmark as a possibility: "*I don't think so, not while things do not change at my school, maybe in four years' time".*

That the school condoned the Grade 11 learners who had failed Physical Science to Grade 12 to continue with Physical Science made the level 2 teacher demotivated because he did not see any possibility of these learners passing, even after all intervention processes were in place. His response to this action by the school management team was: *"This year as well, besides all the effort I put*

into my teaching, 60% may be far-fetched, in our school, learners who do not deserve to be in Grade 12 are presently in Grade 12 because these learners have been condoned to Grade 12, some with very poor results in Physical Science because if they fail Mathematics and Physical Science, they change Mathematics to Mathematical Literacy and keep the Physical Science and progress with it till Grade 12".

The level 4 teachers' lack of classroom management and the inability to employ alternative measures for discipline had demotivated her from even trying. The level 7 teacher was still motivated to produce excellent results, besides his challenges in 2013. He responded this way to a question about the performance of learners who started doing Physical Science in term 02 after the district office had refused to approve the deregistration of two subjects for these learners: *"I am so overwhelmed at times but I'm not giving up. If I don't get 100% because of this challenge, then at least I'm not getting less than 80%".*

Data collected indicated that of the three teachers to whom the issue of motivation was addressed, two were demotivated, i.e., those whose schools performed the worst, but the one whose results were the highest were very motivated amidst challenges. When asked what motivated them to study Physical Science in a questionnaire, all sampled teachers indicated that they loved teaching the subject. However, when asked if they were still motivated the level 1 teacher seemed to be the only one who was unsure.

4.3.2.4 Teachers' interest

The responses of all teachers in interviews on whether they were still interested in teaching Physical Science showed that all teachers were, except for the level 1 teacher whose response was: *Sometimes I am, sometimes I am not. These learners are not working hard and it's like you are the only person who should improve results"*. The interest of this teacher was also measured during classroom observations and moderation of written tasks. Omissions of topics and inability to seek information on time were an indication of lack of interest. The principal of the level 1 teacher had no interest in the subject since he did not ensure that there were enough resources for it at school, or employ a qualified teacher. The

researcher concluded that interest in the subject by all parties involved in school subjects had an influence on its performance**.**

4.3.2.5 Commitment of teachers

Past research done on teacher commitment suggests that commitment relates to the teachers' conscience and identity. Committed teachers want to deliver effective lessons to all learners.

4.3.2.5.1 *Commitment to teaching*

Teachers who are committed to teaching are concerned about the welfare of the learners they teach, the teaching space, learners with learning barriers, learners' individual talents, optimal use of teaching time and preparing for lessons in order to deliver effective lessons.

The researcher observed good practice of one levels 2, the level 6 and the level 7 teacher, in the way they committed themselves to the welfare of their learners. The level 2 teacher had the most clean and well-organised teaching space. He had instilled in his learners that they had to study in a clean, attractive classroom. Learners had displayed some of their Science projects in class and the researcher realised that this offered a sense of satisfaction for them because after the classroom observation, as the researcher went to look at the display in class, the owners came to the researcher to explain the concepts of the projects. It was evident from their gestures that they were happy with themselves. The teacher also travelled the world to attend workshops and seminars on Physical Science teaching at his own initiative and expense and was affiliated with projects within the country that were not funded by the school or the DoE to enhance his teaching of Physical Science. He had collected teaching and learning resources and donated some to the school, his learners and the subject facilitator. All of his learners had basic learning resources for Physical Science, some of which he said he had bought for those who could not afford them, such as calculators and Mathematical instruments.

In the level 6 class there was a learner who sat far in the front. The researcher learned that he could not see clearly from the back and did not have proper

glasses for his condition. The researcher observed that when the teacher wrote on the chalkboard he asked the learner if he could see it clearly. After class the researcher enquired about the possibility of getting parents to get glasses for the learner, to be told that the teacher had already contacted the local hospital to apply for suitable glasses since the learner was an orphan staying with a grandparent who could not do so.

The challenge of the level 7 concerning the 13 learners who had to start taking Physical Science in the second term of 2013 meant that the teacher had to organise extra classes during term 01 school holiday, as well as Saturday classes, morning and afterschool classes to teach these learners work that they missed in term 01. The level 7 teacher lived almost 50 kilometres from the school but when he realised that the learners needed his help he travelled to school during school holidays, at his own expense, to teach them. He also requested intervention by the subject facilitator and made sure that these learners had all resources to help them cope with the term 01 content.

During an interview with the level 7 teachers the researcher realised that he was still positive that the learners would do well if he gave them all the required support. This was his response about the 13 learners:

I'm so scared this year I don't even know what to do. I have thirteen learners who were deregistered Physical Science in term 01 and have now been registered the subject again term 02 because the school did not comply. These learners started doing Grade 12 Physical Science in March, should be ready for the June examination and the trial examination, over the fact that they were my weak learners in Grade Eleven. I now have to make them catch up all term 01 work while I continue teaching term 02 work. I am so overwhelmed at times but I'm not giving up. If I don't get a hundred per cent because of this challenge, then at least I'm not getting less than eighty per cent.

The researcher first established if sampled schools complied with the notional time for Physical Science teaching of four hours per five-day cycle, then further observed if teachers used all contact time fruitfully. Subjects are allocated contact time according to their level of difficulty and the amount of work to be covered in a

year. Any time loss could result in a teacher not having sufficient time to teach and assess learners in a particular topic optimally, thereby compromising their performance in formal tests and examinations. The researcher observed that teachers of all sampled schools arrived at class on time, were in class for the entire period and only left at the end of the period. The notional time for all schools was also compliant, with levels 1 and 4 teachers' times even more, by 30 minutes per week.

With regard to lesson planning, the researcher was not happy with the omission of Chemistry, practical work and higher level assessment questions by the level 1 teacher in term 01. This suggested to the researcher that lessons were not properly planned. The teacher knew when he accepted the teaching post at the school that he would be required to teach Grade 12 but did not take the initiative to comply with the teaching and assessment requirements expected of a Grade 12 Physical Science teacher. The omission of certain aspects of the subject resulted in him offering superficial teaching and assessment to learners.

4.3.2.5.2 *Commitment to learning*

In order to establish if teachers were committed to ensuring that effective learning took place, the researcher observed if they engaged learners during the lesson through discussions and participation, and the principal's willingness to support the Physical Science teacher.

The researcher observed that the level 1 teachers' discussions and oral assessment were characterised by minimum participation and the teacher correcting wrong answers, while level 2 teachers and the level 5 teacher predominantly assimilated information, minimising discussions and often correcting learners if they had given wrong answers. However the level 3 teacher allowed learners to write corrections of work on the board and also allowed other learners to correct wrong answers through discussions with minimal intervention. During explanation of concepts, the levels 6 and 7 teachers allowed learners to give their views and discuss different answers. When the researcher asked how extra classes were utilised by all teachers, it was discovered that the level 7 learners had study groups through which learners studied Physical Science

independently at least once a week in the absence of the teacher. The most effective practice about these study groups was that they had group leaders who kept registers of attendance, content revised and challenges that required the teacher's intervention.

The researcher also established if teachers controlled at least 10% of written tasks and made comments on corrections by learners. The levels 2 and 4 learners wrote corrections with a pencil next to the wrong answer and both had missing corrections about which the teachers did not make any comment. Other teachers had learners rule out work given and write corrections below, with a pen. They explained that the reason for this vigilance in doing corrections this way was that learners used their activity books for revision so they need to have their work well organised. Corrections were also signed by these teachers.

The researcher concluded that the principal of the level 1 school was not concerned about learners' performance in Physical Science; otherwise he would have bought necessary resources to teach the subject or not registered it as an examinable subject in Grade 12. He also employed a person who did not qualify as a teacher nor had enough content to teach Grade 12 Physical Science and still did nothing to ensure that the teacher was capacitated to teach Grade 12 learners. The response of the level 1 teacher to the status of practical activities at the school was*: I haven't done any practical activity in any Grade Ten to Twelve. There is not even one apparatus or chemical to do practical's at the school. I have asked the principal to buy required material and have even given him a list of the material that you gave us but I get excuses every time. I don't know what to do.*

Level 1 learners may not get their results in 2013 if they do not perform practical activities and may also fail because their teacher was not well capacitated with sufficient content to help them pass. The level 7 principal did not show commitment to the 13 learners by allowing them to deregister a subject without ensuring first that their application to change the subject had been granted. The action put pressure on them as well as the teacher, more so because they had to complete the syllabus on time for the trial examinations in August, when they only started with Grade 12 Physical Science content in March. This could compromise the otherwise excellent performance of the school.

4.3.2.5.3 *Commitment to quality*

During the moderation of informal and formal written tasks the researcher checked consistency, fairness and reliability of marking. During this exercise, the researcher realised that the levels 1 to 4 teachers were seldom lenient on marking definitions, laws and principles, in that they often gave marks for explained definitions, whereas the level 5 to 7 teachers were very strict on these in informal tests, an exercise that could be contributing to learners doing well in formal tasks and examinations for these schools, since leniency can sometimes mislead learners into revising wrong answers. The researcher observed that while marking, the levels 5 to 7, teachers wrote comments on learners' books and also used the same marking standards as those used in the final examinations.

In one comment by the level 6 teacher in a learner's book, the researcher observed that to a wrong answer the teacher wrote this comment: "Come see me about this if you have serious problems". This indicated an element of concern about the quality of work taught and reproduced by the learner.

The level 5 teachers' response to a question during an interview indicated his commitment to improving the quality of lessons not previously understood. He responded this way to a question*: I also have a topic in Mechanics - Work Energy and Power that I need to improve in teaching and assessing. I'm not happy with learners' performance in this topic in term 01 test, but I will re-teach it.*

In response to interview questions before school visits on whether they were committed to ensuring that each lesson they taught was fruitful, all sampled teachers responded with a "*yes*". The researcher discovered that teachers understood that commitment to quality lessons can affect the performance of learners.

4.4. CONCLUSION

In this chapter the researcher summarised the findings of the study in terms of how factors related to teacher quality affected the performance of Physical Science. In order to answer this question, the researcher first established the status of teacher quality using the past years performance in Physical Science and

the performance of learners in the first test of 2013. The overall status of Tshwane South district revealed that there was sufficient quality to teach Physical Science based on the quantity and the quality of the 2012 Grade 12 final results. Data collected on factors directly related to teaching indicated that good performance in the combination of these factors resulted in good sustainable performance in Physical Science as opposed to good performance in one or two of these factors. Data on factors indirectly related to teaching revealed that these are not independent from the factors directly related to teaching but incorporated in them. They may not be measured the same way as those directly related to teaching but have a great influence on actual teaching practices and consequently the performance of Physical Science in Tshwane South district. The researcher was satisfied with data collected in an attempt to answer the primary question.

The next chapter presents discussion of the findings, makes recommendations for future study and draws conclusions.

CHAPTER 5

DISCUSSIONS OF THE STUDY, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

In this chapter the researcher summarised findings from the investigation in an attempt to address the primary question of this study through evidence presented by answers to the secondary questions. The discussions of the findings provide a link between the findings in Chapter 4 and the literature reviewed in Chapter 2 on how factors related to teacher quality affect the performance of Physical Science in Tshwane South District. In this study, raw data and other data collected from questionnaires, interviews, document analysis and observations was analysed and compared to findings from literature reviewed in order to provide a clear understanding during discussions. Conclusions are drawn on how factors related to teacher quality affected the performance of Physical Science from data collected and responses of teachers. Recommendations are directed to the DoE, the GDE, district offices, school management teams and Physical Science teachers for remedial and preventive measures that could be employed to improve the quality of teaching and hence reduce poor performance as well as sustain or further improve good performance. This chapter also presents implications for future study.

5.2 SUMMARIES OF MAJOR FINDINGS

Findings reflected an overall high pass percentage of Physical Science at the end of 2012 in Tshwane South district, as well as the high number of learners who obtained university entrance in Physical Science. The number of learners who obtained 50% and above in Physical Science was also high for Tshwane South district. Findings on the perfomance of learners in the first control test in 2013 also reflected a perfomance of 60% and above for all schools that gave compliant control tests. The reseacher used the overall pass percentage of the Grade 12 Physical Science results in 2012 and results of the first control test in 2013 as a measure of the status of teacher quality in the district and based on this evidence,

the researcher concludes that the quality of Physical Science teaching in Tshwane South district is of acceptable standards.

5.2.1 Factors directly related to teaching

5.2.1.1 Teachers' qualifications

Findings reflected that most teachers in Tshwane South district have sufficient formal Physical Science teaching qualifications to teach Grade 12 learners according to the qualification requirements set by the DoE in South Africa. When comparing the performance of teachers in relation to their qualifications, findings showed that non-qualified and under-qualified teachers produced poor results. The qualifications of teachers' were very different, with other teachers having obtained three-year teaching diplomas, some four-year teaching diplomas and others four-year degrees. There were also additional qualifications such as the ACE and PGCE in addition to existing qualifications, which were either subject-specific or management-related. Some qualifications were content-specific without being a professional teacher's qualification.

The argument by Parker (2011) that the performance of Physical Science is affected by the type of qualification that teachers possess was supported by findings from this study which revealed that some teachers who have a three-year teaching qualification in Physical Science still produced poor results. Most teachers who have a three-year teaching qualification had not updated their formal qualifications in the subject. All teachers who had produced results which were below the 60% benchmark had not updated their qualifications since they graduated from tertiary institutions. Teachers who were more qualified in teaching of Physical Science produced excellent results in the subject and confirmed the statement made by Parker (2011) that advanced degrees in Physical Science teaching can result in high school performance in Physical Science. Vallicelli (2012) and King Rice (2003) add that more qualifications increase the intellectual perfomance of teachers. Teachers understood that quaifications can affect the perfomance of a subject. The number of qualified Physical Science teachers in the district correlated with the high pass percentage of Physical Science in Tshwane South district in 2012.

5.2.1.2 Attendance at workshops

Findings that the majority of teachers in Tshwane South schools had consistently attended workshops for the previous three years concurred with a statement by the Teacher Professional Model (2003) that continuous professional development expands and deepens teaching practices. For a curriculum that has been changing, the study aligned itself with findings by the NSTA (2007) that Physical Science teachers need to continually improve their personal and professional development. All teachers who had obtained acceptable results had consistently attended most content workshops and those who attended the least number of workshops had not produced acceptable results. Some teachers had consistently attended content workshops but had produced unacceptable results; however findings revealed that their performance was gradually increasing. Most sampled teachers indicated that they had benefited from content and pedagogical workshops offered in the past three years.

5.2.1.3 Teaching Experience

Findings by the National MST (2001) indicated that more experienced Physical Science teachers are associated with high level of learner achievements. Findings from this study revealed that there were more experienced teachers in Tshwane South district who had consistently been teaching Grade 12 Physical Science. More experienced teacher in the subject produced satisfactory results. Non-experienced and the least experienced teachers who frequently had their experience in teaching Grade 12 disturbed by the rotation system of the school produced poor to moderate results but never excellent results. Teachers with the least experience had produced less quality results compared to the more experienced ones. These finding concurred with those of Harris and Sass (2007) that teachers grow in effectiveness over at least five years of their job, and of Darling-Hammond (2000) who indicated that teachers with less than three years teaching experience were less effective.

5.2.1.4 Teachers' content and pedagogical content knowledge

The NBSTA argues that teachers have to know the subject they teach and how to teach it. Makgato and Mji (2006) add that effective teaching involves effective use

of pedagogical content knowledge. Findings from this study revealed that teachers in Tshwane South district who produced 50% and more in the subject had sufficient content knowledge in the subject and they coupled this with effective use of resources and teaching methodologies. Teachers who had sufficient content knowledge but did not use resources available for teaching did not deliver good lessons or produce good results. The finding confirmed that of the National Research Council (NRC) of 1999 that the combination of content knowledge and pedagogical content knowledge is necessary to achieve desired outcomes. Teachers who had insufficient content knowledge did not produce good results (The Teachers Professionalism model, 2003).

Baloyi (2011) argues that teachers cannot teach what they do not know or understand. Learners can see teachers who do not have sufficient content knowledge and such teachers lose the respect and trust of their learners. The NRC writes: “For educators to impart effective knowledge to Physical Science learners, they themselves need to possess efficient content knowledge and skills in the subject”. Content and pedagogical content knowledge shows during teaching practice in the quality and quantity of assessment tasks.

5.2.1.5 Teachers’ competence

Vallicelli (2012) argues that competent teachers always pursue excellence. Competence is a combination of several teaching practices. Findings from this study showed that teachers who had given excellent lessons and quality assessment activities, who had prepared for lessons and made a follow-up on all lessons taught to ensure that learners understood, had consistently produced good results and had a good rapport with their learners. They varied teaching strategies to suit the lesson and the type of learners they taught. Competence helps to build confidence, increase self-confidence and improve ability to solve everyday problems. The researcher discovered that teachers who had produced consistently good results strived for excellence from their learners, and were not satisfied with “just enough”.

The researcher regarded these teachers as competent, based on characteristics from past studies. Teachers who had produced good results refined their

knowledge. Incompetent teachers either did not teach all content or did not cover all assessment tasks as was expected, and had no valid reason not to do so. Some teachers who had not produced good results had not done all things that categorise teachers as competent. They had not made an extra effort to ensure that they delivered effective lessons. They got some of the things correct and some not, for example, they would utilise resources available but not comply with assessment practices.

5.2.2 Factors indirectly related to teaching

5.2.2.1 Teachers' professional conduct

Findings from this study revealed that Physical Science teachers in the Tshwane South district had good professional conduct and were liked by their principals because of the professionalism they displayed at their workplace. Teachers also understood the importance of acceptable conduct in their profession.

5.2.2.2 Teachers' attitude

When teachers have a positive attitude to the subject, they become independent, competent and resourceful. Findings by Kriek and Grayson (2009) indicated that various unprofessional attitudes were widespread in schools, such as being late for class, not preparing for class and omitting sections in the syllabus that they are not comfortable teaching. Teachers who delivered good lessons were those who had prepared well so that all content that was expected to be covered was taught and assessed. No omission of content or assessment was observed with those teachers, either during teaching time or in records of their learners' written tasks. These characteristics were observed in teachers who produced good results.

Teachers who had a positive attitude towards Physical Science influenced their learners to do the same. Their attitude to the subject was also reflected by the learners who participated fully in the lesson and performed well in the subject in both formal and informal assessment tasks. Teachers who had displayed poor teaching and assessment practice were those who had also produced poor to moderate results. There had been omissions in their teaching and assessment

practices and they did not show much concern about the performance of their learners. The researcher regarded such as the result of a negative attitude.

5.2.2.3 Teacher motivation and interest

Howie (1999) indicated that self-motivated teachers do not require any third party encouragement to teach, and can seek out and assimilate the required body of knowledge. Teachers, who are motivated and interested to teach Physical Science overcome all challenges and still believe that with proper teaching and assessment, their learners can learn and pass. When learners are aware of the teacher's interest in their performance as well as their personal lives, they work harder. Mphahla (2009) concedes that when teachers show interest in their work they become effective mentors to their learners even in issues that are not necessarily related to the content, as well as other issues that might have an impact on their learning. They guide and support learners to ease them through difficult transitions, smoothing the way, enabling, reassuring as well as directing, managing and instructing.

They are able to unblock learners' ways to change by building self-confidence, self-esteem and a readiness to act as well as to engage in on-going constructive interpersonal relationships. Findings from this study revealed that all teachers who showed motivation and interest in teaching Grade 12 Physical Science continued to produce good results, while those who had not produced good results had an excuse in the performance of their learners. The latter regarded challenges that they encountered in teaching as hampering their performance.

5.2.2.4 Teacher commitment

Commitment relates fundamentally to the question of teacher identity, a teacher's conscience, and the ways of knowing and being. Unless teachers are committed and disciplined professionals who take who take their authority seriously, little can be achieved. Theron and Dunn (2006) add that in spite of being highly qualified and experienced, some teachers have low morale and poor commitment. A report conducted by Makgato and Mji (2006) also revealed that another cause of underperformance in the school was non-completion of the syllabus by teachers, caused by them spending too much time teaching content that they were

comfortable with and happened to be easy for learners, but neglecting challenging concepts.

Past researchers indicate that commitment is the teachers' decision to teach and assess correctly. In addition to qualifications and experience, commitment of teachers to the subject can affect the performance of learners. Makgato and Mji (2006) relate non-completion of the syllabus, teaching and assessing easy things only and neglecting other examinable content as characteristics of non-commitment. This study revealed that schools that performed poorly had teachers who omitted certain sections in the work schedule in terms of teaching or assessing them and had not assessed all examinable content and skills.

Teachers who had produced good results had complied with the teaching and assessments requirements for Grade 12 and also had provision for intervention classes. The type of assessment tasks that teachers who produced good results gave to learners prepared them for the external examinations. Some teachers, whose performance was not good, gave sufficient work but the quality was unacceptable. All committed teachers produced good results; they took the initiatives of giving effective lessons and were in the forefront for their learners. Non-committed teachers had an excuse for non-compliance and poor performance.

5.3 CONCLUSIONS AND RECOMMENDATIONS

The information gathered by TIMSS put the spotlight on Science education in South Africa and contributed to the introduction of various initiatives in Physical Science education in South Africa. Comparing learner performance in Physical Science and the education system with that of other countries may result in many lessons being learned for the future and, thereby, many support the successful implementation of Science education reform. Cognisance must be taken of the time needed for the changes and reforms to be developed and implemented before their impact can be measured.

The situation in Science education cannot be rectified overnight, as it is the result of many complex factors impacting over a significant time (Howie, 1999). It is believed that only a comprehensive, strategic, and collaborative national effort can

meet the challenges that South Africa faces in the reformation of Science education. The TIMSS scores suggest that even at the school level, where learners are educated in formal Science knowledge, scientific literacy is low (Reddy, 2006).

As there have been major concerns among the proponents of education reform since the early 1980s, more attention on the status of teachers is required. At the ASSAF presentations in 2009, Surtey indicated that qualified and committed teachers remain the mainstay of the system of education. The Department of Basic Education is aware that the sustainability of efforts in Physical Science education depends on the availability of suitably qualified teachers. This call for standards might be feasible through the selective admission to the accredited teacher education programmes and formal induction into a professional development school of the candidates.

In many countries there is a belief that anyone can teach anything. Prescriptive teaching methods that come into education systems are part of the problem as they communicate to teachers that they are generalists rather than specialists, and can be deployed anywhere. This undermines the professionalism and confidence of teachers. The need for quality teaching in South Africa is compromised by teachers who are not fully committed to their work. Initial teacher education, in-service training and the development of professional ethics and values were set out as strategies to enhance teacher professionalism by the DoE in 1999.

For South Africa to succeed in improving the quality of its education, professional teacher development and support has to be central to its intervention strategies. The Commonwealth delegates (2011) argued that in order to enhance the professionalism of teachers and address the continuing challenge of the devalued professional status of teachers across Commonwealth countries, in comparison to other professions, a plan is required to actively encourage teacher training, recognition of teacher qualifications, professional registration of teachers and development of professional teacher standards.

Only with competent, dedicated, inspiring teachers will Science education reform be possible. Parker (2011) believes that standards should be developed by

looking at teacher education practitioners in the system, and working with them and other stakeholders to define standards. Developing communities of practice could be used to examine how to create standards in the system. There is scope to facilitate the moderation of qualifications across all universities. Jansen (2011) indicates that to succeed in improving the quality of education in this country, professional teacher development and support have to be central to intervention strategies.

The following conclusions arose from the findings, and are presented here with recommendations.

5.3.1 Upgrading qualifications

Many teachers had acceptable qualifications to teach Physical Science, however most practicing teachers had out-dated Physical Sciences teaching qualifications to match the demand of the changing curriculum in this country. Most teachers also indicated that they viewed high qualifications as a contributory factor to good results. The researcher recommends the following activities:

5.3.1.1 Recommendations to the Provincial Departments of Education or District officials

The GDE should make an awareness campaign to all teachers in the province for upgrading Physical Science teaching qualifications on content and pedagogy. They should also liaise with higher education institutions to structure programmes for attendance of teachers to these upgrading courses in a way that would attract many teachers to attend, e.g., classes for a group of districts which are closer together, either on some days during the week from 14h30 to 17h30 or on Saturdays, instead of centralising them at higher education institutions which are far from other teachers and classes are mostly at unreasonable hours for most teachers. Upgrading courses should be relevant to the current needs of the curriculum in terms of content and pedagogy and be accredited by higher education institution as a formal qualification.

5.3.1.2 Recommendations to Physical Science teachers

Physical Sciences teachers need to take advantage of the advanced certificate and any other available higher qualification available at universities, but take Physical Science, Physics, and Chemistry as major subjects so as to improve their content knowledge, instead of education management courses. Once they have committed to attending such programmes they should complete them.

5.3.2 Continuous development of teachers through workshop, meetings and induction of teachers

The attendance of teachers at workshops was satisfactory in the Tshwane South district but past studies indicated that teachers attended workshop if these were beneficial to them. The researcher recommends the following activities:

5.3.2.1 Recommendations to Provincial Department of Education or District officials

The researcher related non-attendance of other teachers to workshops as lack of interest since the same topics seem to be addressed each year. Some teachers may not need help in these workshops but may have other areas of development which influence teachers and that may also need to be addressed. The researcher recommends that the above stakeholders collect needs analysis for teachers a year before planning for workshops. The plan for all workshops and subject meetings should be provided at the beginning of the year to all teachers for all annual workshops and meetings, so that they can avoid clashes of attendance with other work related activities. Coordinators of these workshops and meetings should be conversant with the Physical Sciences content, pedagogy and use of resources required to upgrade the standard of teaching this subject. Workshops should be needs-driven for specific group of teachers and not follow a uniform approach, which might discourage other teachers from attending. Guidance to HoDs on how to induct new teachers should be included in the workshops.

5.3.2.2 Recommendations to School Management teams and Physical Science teachers

HoDs who have sufficient subject knowledge are in a better position to offer subject guidance to other teachers. Schools should employ HoDs and teachers who have Physical Science teaching qualifications to meet the needs of the subject. HoDs should induct new teachers and continually hold subject meetings and workshops where there are challenges in the subject, and good practice should be shared. Physical Science teachers need to attend all workshops and meetings that are beneficial to them.

5.3.3 Physical Science curriculum structuring and retraining of teachers

The DoE should stabilise the Physical Science curriculum and not make frequent changes so that teachers can be grounded in the content knowledge and pedagogy of the curriculum. Most teachers who have not produced good results have not pursued further qualifications, which may be a result of them being left behind by current content and pedagogy. Workshops are important in orientating teachers but can be insufficient if there are frequent changes in the curriculum which can result in confusion or lack of attendance to these workshops.

The GDE should offer retraining for teachers which should not be superficial crash courses that take a maximum of five days as the situation is currently, but rather prolonged one-year courses that will ensure successful implementation of the changes.

The changing South African curriculum requires Physical Science teachers to keep up with the current trends if they wish to produce good results. To do this the researcher recommends that subject facilitators, Physical Science HoDs and Physical Science teachers should consistently make their own research on topics taught as well as teaching methodologies as a way of retraining themselves.

5.3.4 Subject choice and screening of Physical Science learners

According to findings, the issue of condoning learners to the next grade is a major source of underperformance in Physical Science. Some of the teachers whose

performance have not reached the required benchmark over the previous years in Grade 12 had been teaching learners who had not passed Physical Science in Grade 11 and were expected to produce good results. The DoE should adopt a policy pertaining to the screening of learners taking Physical Science in the Further Education and Training (FET) phase so that the subject can be taken by learners who have a good chance of passing it in Grade 12. The DoE should also pass a policy that will not allow learners to combine Physical Science with Mathematical literacy instead of Mathematics because many applications of Physical Science require the knowledge of Mathematics.

5.3.5 Utilisation of teacher support groups to develop each other

All teachers who produced good results had sufficient pedagogical content knowledge and some who produced moderate results had acceptable levels of subject knowledge, while those whose performances were very poor had unacceptable content knowledge. Experienced teachers were also more knowledgeable in the subject. The researcher suggests that teachers should form and utilise support groups for information sharing, where excellent teachers share good practices and poor performing teachers. Groups can be formed for teachers within a particular geographic area. In order to upgrade the standard of assessment practices, teachers within the same support group can share assessment activities and information on how to utilise ICT teaching resources such as laptop, tablets and cell phones to teach Physical Science. HoDs should provide teachers with all teaching and learning resources early in the beginning of the year and ensure utilisation thereof throughout the year, by monitoring teaching practices through class visits and moderation of written tasks. In the case of resources not being utilised because teachers cannot do so, the school management teams needs to organise training on the use of such resources for teachers. They need to reinforce the subject knowledge of teachers by upgrading and ensuring utilisation and proper management of laboratories and ICT teaching resources.

5.3.6 Management of the subject at school level

Teachers who performed poorly either did not have an HoD or had an HoD who was not a Physical Science specialist or one who did not manage the subject well. Some of the findings made by the researcher, such as non-control of books, insufficient work, omission of topics and tasks or types of examinable questions, should have been discovered by the HoD first and rectified on time. Regular classroom visits, subject meetings and moderation of teachers' work allow the HoDs to identify challenges in Physical Science well in advance so that he/she can address them. The researcher recommends that Physical Science HoDs should conduct classroom visits to monitor teaching and assessment practices, completion of formal tasks, curriculum progress, and moderate the quantity and quality of learners' written task. They should encourage teachers to plan thoroughly for all activities using work schedules beforehand and ensure that no omission in quality teaching or assessment is done. They should strive to produce quality, maximum pass percentages.

5.3.7 Provision of resources and symposiums

Most of the teachers, who showed lack of commitment and unacceptable attitude to the subject, had lost interest in the subject and were no longer motivated to teach it, were those who teach in schools that are underperforming. Most of the underperforming schools are under-resourced. The DoE should ensure that all under-resourced schools are provided with minimum resources that will enable teachers to deliver effective lessons. Factors mentioned above are difficult to measure, hence difficult to address. The GDE and district offices should hold symposiums to address motivation, attitude and use of resources to resuscitate the interest of Physical Science teachers in the subject.

5.4 IMPLICATIONS FOR FURTHER RESEARCH

The findings from the study have revealed the impact of various factors that directly and indirectly affect the performance of Physical Science .The researcher feels that in order to provide an in-depth account of the performance of Physical Science; further research can be done on the following topics:

- The impact of teacher support group forums on the performance of Physical Science as opposed to content and pedagogical workshops.
- The impact of the use of Information and Communication Technology (ICT) resources on the performance of Physical Science.
- The impact of effective utilisation of Science laboratories on the performance of Physical Science.
- The implementation of mentoring sessions to develop teachers instead of teacher workshops.

5.5 CONCLUSION

This study was conducted at schools in the Tshwane South district whose characteristics, those of teachers and learners and the resources that they have are similar. The study presented findings on how factors that are directly and indirectly related to teacher quality affect the performance of Physical Science. In order to make generic and specific conclusions of the findings, the researcher saw it necessary to establish the status of teacher quality, and so relate the overall performance of the subject to this. To make conclusions on the status of teacher quality, the researcher used the quality of the Physical Science results in Tshwane South district. Findings from analysed data indicated that the overall status of teacher quality in Tshwane South district is satisfactory. The researcher went on to establish how factors directly and indirectly related to teacher quality affected the performance of Physical Science in the district through raw data, questionnaires and interviews. All factors that were studied were then compared to the quality of the Physical Science results at the end of 2012.

Factors which are directly related to teaching could be observed through actual classroom observations and document analysis. Findings from this study were not consistent for all participants; however the researcher established that good to excellent performance of teacher (60% to above 80%) displayed good practice in most or all of these factors together. This implies that teachers who had sufficient to high qualification in Physical Science had upgraded their qualifications, consistently attended teacher development workshop, and were inducted to the profession when they started working, were competent, had more experience and had sufficient knowledge to teach Physical Science in Grade 12. Teachers who

produced the poorest results (0% to 30%) displayed good practice to the least number of these factors whereas those who produced moderate results (31% - 59%) displayed good practice in at least half of these factors. Findings on these factors from questionnaires and interviews seldom provided contradictory data, for example an incompetent teacher according to evidence gathered through classroom observations indicated that he or she is competent in an interview; hence the researcher used various data collection instruments for the same data in order to collect reliable information required for this study.

Findings from factors which are indirectly related to teaching were subjective in that the researcher mostly could not measure them quantitatively. Some of them could be observed and some were implied by teachers' responses from interviews and questionnaires responses using past research findings. This implies that teachers who had acceptable professional values, conduct, ethics, behaviour, positive attitude towards subject and those who showed motivation, interest and commitment to effective teaching collectively, produced good results. Findings were not consistent in cases where responses from interviews contradicted those from questionnaires.

The impact of factors related to teaching, whether directly or indirectly, collectively affects the standard of teaching, and consequently the performance of Physical Science. The findings also revealed that the performance of learners reflect the performance of their teachers. All recommendations made are possible to implement by all stakeholders identified and can change the status of the performance of Physical Science in terms of eradicating poor performance and sustaining good performance. Tshwane South generally performs better in the province in Physical Science and is capable of doing even better with the right processes in place.

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APPENDIX A

Application to the Gauteng Department of Education

GAUTENG DEPARTMENT OF EDUCATION

education
Department: Education
GAUTENG PROVINCE

RESEARCH REQUEST FORM

REQUEST TO CONDUCT RESEARCH IN INSTITUTIONS AND/OR OFFICES OF THE GAUTENG DEPARTMENT OF EDUCATION

1. PARTICULARS OF THE RESEARCHER

1.1	Details of the Researcher
Surname and Initials:	STEPHEN M M
First Name/s:	MMAPASEKA MAGDELINE
Title (Prof / Dr / Mr / Mrs / Ms):	MRS
Student Number (if relevant):	3163-791-4
ID Number:	7204060530087
Gender (Male/Female):	FEMALE

1.2	Private Contact Details
Home Address	*Postal Address (if different)*
703 CHOSEN HOUSE FLATS	P O BOX 29991
214 RISSIK STREET	SUNNYSIDE
SUNNYSIDE	
Postal Code:0002	*Postal Code:0132*
Tel:(W) 012 401 6355	
Cell: 0726915562	
Fax to email: 0862041252	
E-mail: Mmapaseka.stephen@gauteng.gov.za	

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2. PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	Purpose of the Research (Place cross where appropriate)
Undergraduate Study - Self	
Postgraduate Study - Self	X
Post-Doctoral Study	
Private Company – Commissioned by Provincial and/or National Government Department/s	
Private Research by Independent Researcher	
Non-Governmental Organisation	
National Department of Education	
Commissions and Committees	
Independent Research Agency	
Statutory Research Agency	
Independent Study by Higher Education Institution	

2.2	Full title of Thesis / Dissertation / Research Project
HOW DOES TEACHER PROFESSIONALISM AND TEACHER QUALITY AFFECT THE PERFOMANCE OF PHYSICAL SCINCES IN TSHWANE SOUTH DISTRICT-GAUTENG	

2.3	Value of the Research to Education (Attach Research Proposal)
HELP IDENTIFY ISSUES ABOUT TEACHERS AND IN TEACHING THAT CAN HELP IMPOROVE THE PERFOMANCE OF BOTH PHYSICAL SCIENCE EDUCATORS AND LEARNERS	

2.5	Student and Postgraduate Enrolment Particulars (if applicable)
Name of institution where enrolled:	UNISA
Degree / Qualification:	BED HONOURS - NATURAL SCIENCES
Faculty:	EDUCATION
Department:	EDUCATION
Name of Supervisor / Promoter:	Dr. A MOTLHABANE

2.6	Employer (where applicable)
Name of Organisation/School:	TSHWANE SOUTH DISTRICT
Position in Organisation:	SENIOR EDUCATION SPECIALIST
Head of Organisation:	MS. H KEKANA

Street Address:	PRESIDENT TOWERS BUILDING
	265 PRETORIUS STREET
	PRETORIA
Postal Code:	0002
Telephone Number (Code + Ext):	012 401 6355
Fax Number:	012 401 6351
E-mail:	Mmapaseka.stephen@gauteng.gov .za

2.7	**PERSAL Number (where applicable)**

9	0	1	8	7	5	5	5

3. PROPOSED RESEARCH METHOD/S

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

3.1 ***Questionnaire/s (If Yes, supply copies of each to be used)***

YES	**X**	**NO**	

3.2 ***Interview/s (If Yes, provide copies of each schedule)***

YES	**X**	**NO**	

3.3 ***Use of official documents***

YES	**X**	**NO**	
If Yes, please specify the document/s:Grade 12 Physical Sciences mark analysis for the past three years			
SBA reports for 2011 term 01,&02 &03 2012			
Physical Sciences mark analysis term 01,02 &03 2012			

3.4 ***Workshop/s / Group Discussions. (If Yes, Supply details)***

YES		**NO**	**X**

3.5 ***Standardised Tests (e.g. Psychometric Tests)***

YES		**NO**	**X**
If Yes, please specify the test/s to be used and provide a copy/ies			

4. INSTITUTIONS TO BE INVOLVED IN THE RESEARCH

4.1 ***Types of Institutions. (Please indicate by placing a cross alongside all types of institutions to be researched).***

INSTITUTIONS	Mark with "X" here
Primary Schools	
Secondary Schools	X
Technical Schools	
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Other	

4.2 *Number of institution/s involved in the study.* (Kindly place a sum and the total in the spaces provided).

Type of Institution	Total
Primary Schools	
Secondary Schools	07
Technical Schools	
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Other	
GRAND TOTAL	

4.3 *Name/s of institutions to be researched.* (Please complete on a separate sheet and append if space is deemed insufficient).

Name/s of Institution/s
MAMELODI HIGH
WF NKOMO
HOLY TRINITY
PRETORIA INSTITUTE
BOKGONI
VLAAKFONTEIN
PROSPERITUS

4.4 *District/s where the study is to be conducted.* (Please mark with an "X").

District	
Ekurhuleni North	
Ekurhuleni South	
Gauteng East	
Gauteng North	
Gauteng West	
Johannesburg Central	
Johannesburg East	

District	
Johannesburg North	
Johannesburg South	
Johannesburg West	
Sedibeng East	
Sedibeng West	
Tshwane North	
Tshwane South	x
Tshwane West	

Office/s (Please indicate)

NOTE:

If you have not as yet identified your sample/s, a list of the names and addresses of all the institutions and districts under the jurisdiction of the GDE is available from the department at a small fee.

4.5 *Number of learners to be involved per school.* **(Please indicate the number by gender).**

Grade	*1*		*2*		*3*		*4*		*5*		*6*	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number												

Grade	*7*		*8*		*9*		*10*		*11*		*12*	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number											12	9

4.6 *Number of educators/officials involved in the study.* **(Please indicate the number in the relevant column).**

Type of staff	Educators	HODs	Deputy Principals	Principal	Lecturers	Office Based Officials
Number	7	7	0	7	0	0

4.7 *Are the participants to be involved in groups or individually?* **Please mark with an "X".**

Participation	
Groups	
Individually	x

4.8 *Average period of time each participant will be involved in the test or any other research activity* (Please indicate time in minutes)

Participant/s	Activity	Time
Learners tasks	Moderation of written tasks	30 minutes per learner task
Grade 12 educator	Classroom observations	30 minutes x 7 educators
	Interviews	60 minutes x 7 educators
	Completion of questionnaires	30 minutes x 7 educators
Principals	Interview	60 minutes x 7 principals

4.9 *Time of day that you propose to conduct your research.* Please mark with an "X".

School Hours	During Break	After School Hours
Classroom observations-during the day		Interviews, completion of questionnaires, collection of qualifications and workshops data – after school hours

4.10 *School term/s during which the research would be undertaken.* Please mark with an "X".

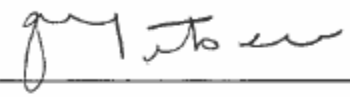
First Term	Second Term	Third Term
X-2013		

DECLARATION BY THE RESEARCHER	
1. *I declare that all statements made by myself in this application are true and accurate.* 2. *I have read and fully understand all the conditions associated with the granting of approval to conduct research within the GDE, as outlined in the GDE Research Briefing Document, and undertake to abide by them.* 3. *Should I fail to adhere to any of the approval conditions set out by the GDE, I would be in breach of the agreement reached with the organisation, and all privileges associated with the granting of approval to conduct research, would fall away.*	
Signature:	
Date:	04 September 2012

DECLARATION BY SUPERVISOR / PROMOTER / LECTURER

I declare that: -

1. *The applicant is enrolled at the institution / employed by the organisation to which the undersigned is attached.*
2. *The overall research processes meet the criteria of:*
    - *Educational Accountability*
    - *Proper Research Design*
    - *Sensitivity towards Participants*
    - *Correct Content and Terminology*
    - *Acceptable Grammar*
    - *Absence of Non-essential / Superfluous items*

Surname:	**Motlhabane**
First Name/s:	**Abraham Tlhalefang**
Institution / Organisation:	**UNISA**
Faculty:	**Education**
Department:	**Science and Technology Education**
Telephone:	**012 429 2840**
Fax:	**0865410727**
Cell:	**0723622732**
E-mail:	**motlhat@unisa.ac.za**
Signature:	
Date:	**13 November 2012**

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to Nomvula Ubisi at nomvulau@gpg.gov.za. The last page of this document must however contain an original signature and may be faxed or hand delivered. Mark fax - For Attention: Nomvula Ubisi at 086400908 (fax) or hand deliver (in closed envelope) to Room 525, 111 Commissioner Street, Johannesburg.

APPENDIX B

Application letter to the District Director

703 CHOSEN HOUSE FLAT
249 RISSIK STREET
SUNNYSIDE
0002
16 JULY 2012

The Provincial official
Tshwane South District
President Towers
Madam

Application for permission to conduct a research study at schools in our District

I am currently enrolled with Unisa for a master's degree in Natural Science Education studies-specializing specifically with Physical Science Education. Part of my studies requires me to do field work at the site. My studies will require the participation of Physical Science Grade 12 educators and their principals for interviews and data collection from lesson observations as well as learners written tasks.

I am requesting your permission to conduct my studies at the following schools: Mamelodi secondary school, Dr. WF Nkomo, Holy Trinity Catholic School, Pretoria Institute for learning, Bokgoni Technical High school, Vlaakfontein secondary school, Prosperitus secondary school.

Information collected from participants will be treated as confidential and will only be used for purposes of the research only.

Thanking you in advance

M M Stephen (Physical Science facilitator)

APPENDIX C

Application letter school Principals

703 CHOSEN HOUSE FLAT

249 RISSIK STREET

SUNNYSIDE

0002

16 JULY 2012

The Principal

Madam

Application for permission to conduct a research study at your school

I am currently enrolled with Unisa for a master's degree in natural Science Education studies-specializing specifically with Physical Science Education. Part of my studies requires me to do field work at the site. My studies will require the participation of Physical Science Grade 12 educators and their principals for interviews and data collection from lesson observations as well as learners written tasks.

I am requesting your permission to conduct my studies at your schools. Information collected from participants will be treated as confidential and will only be used for purposes of the research only.

Thanking you in advance

M M Stephen (Physical Science facilitator)

APPENDIX D

Application to teachers

703 CHOSEN HOUSE FLAT

249 RISSIK STREET

SUNNYSIDE

0002

16 JULY 2012

The Principal

Madam

Application for permission to conduct a research study with you as a participant

I am currently enrolled with Unisa for a master's degree in natural Science Education studies-specializing specifically with Physical Science Education. Part of my studies requires me to do field work at the site. My studies will require your participation for interviews and data collection from lesson observations as well as learners written tasks.

I am requesting your permission to conduct my studies with you at at your schools. Information collected from you will be treated as confidential and will only be used for purposes of the research only.

Thanking you in advance

M M Stephen (Physical Science facilitator)

ANNEXURE E

Approval letter from GDE

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2013/244

GDE RESEARCH APPROVAL LETTER

Date:	23 November 2012
Validity of Research Approval:	4 February 2013 to 27 September 2013
Name of Researcher:	Stephen M.M.
Address of Researcher:	P.O. Box 29991
	Sunnyside
	0132
Telephone Number:	012 401 6355 / 072 691 5562
Fax Number:	086 204 1252
Email address:	Mmapaseka.stephen@gauteng.gov.za
Research Topic:	How does teacher professionalism and teacher quality affect the performance of Physical Science in Tshwane South District, Gauteng
Number and type of schools:	SEVEN Secondary Schools
District/s/HO	Tshwane South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

23/11/2012

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Dr David Makhado

Director: Knowledge Management and Research

DATE: 2012/11/23

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

ANNEXURE F

Consent form from one principal

INFORMED CONSENT FORM

NAME OF RESEARCHER: MAGDELINE MMAPASEKA STEPHEN

ADDRESS OF THE RESEARCHER: 703 CHOSEN HOUSE FLATS
214 RISSIK STREET
SUNNYSIDE
0002

CONTACT DETAILS OF THE RESEARCHER: 072 691 5562 (CELL)
Mmapaseka.stephen@gauteng.gov.za

INSTITUTION THAT GIVES ETHICAL APPROVAL: UNISA

RESEARCH TITLE: How does teacher professionalism and teacher quality affect the performance of physical sciences in Tshwane south district-Gauteng Province

PURPOSE OF THE RESEARCH: Identify issues about teachers and teaching that can help improve the performance of physical sciences for teachers and learners

PROCEDURE OF THE RESEARCH: Interview principals and teachers on factors related to teacher professionalism; analyze the physical sciences results for the past three years in relation to teachers experience and qualifications, questionnaires on factors related to teacher quality and classroom observations as well as moderation of learners written tasks.

DURATION OF THE RESEARCH: Three to six months

I appreciate your willingness to participate in the study. I will inform you on the date and the time that I will come for site research at your institution

- For this research you will be interviewed, be provided with a questionnaire, have your lesson observed in a normal setting and have three of your learners written tasks (high, moderate and low)moderated
- Your participation in this study is voluntary, you are not obliged to divulge any information you don't wish to and you may withdraw from the study if you wish to without any fear of penalty.
- I will treat information given to me as confidential. You will not be identified in any document, including interview transcripts and the research report by your surname, first name or by any other information nor will the name of your school be mentioned.
- The research does not involve any risk, however if any discomfort is experienced, every effort will be done to keep it minimal.
- The research finding will be made available to you at you request.
- Should you have any quenes about the research, now and the future, you are free to contact me at the numbers given above.
- The will not be any benefits/compensation due to you for participating in this study.
- I appreciate your willingness to help me complete this study.

I understand the contents of this document and agree to participate in this research.

Signature of participant: Mathibela H.T Date: 21/1/2013

Name: T.H.E.L.M.A

SAULRIDGE SECONDARY SCHOOL
P.O BOX 161
2013 -01- 21
ATTERIDGEVILLE
DEPARTMENT OF EDUCATION

APPENDIX G

Consent form from one teacher

INFORMED CONSENT FORM

NAME OF RESEARCHER: MAGDELINE MMAPASEKA STEPHEN

ADDRESS OF THE RESEARCHER: 703 CHOSEN HOUSE FLATS
214 RISSIK STREET
SUNNYSIDE
0002

CONTACT DETAILS OF THE RESEARCHER: 072 691 5562 (CELL)
Mmapaseka.stephen@gauteng .gov.za

INSTITUTION THAT GIVES ETHICAL APPROVAL: UNISA

RESEARCH TITLE: How does teacher professionalism and teacher quality affect the performance of physical sciences in Tshwane south district-Gauteng Province

PURPOSE OF THE RESEARCH: Identify issues about teachers and teaching that can help improve the performance of physical sciences for teachers and learners

PROCEDURE OF THE RESEARCH: Interview principals and teachers on factors related to teacher professionalism; analyze the physical sciences results for the past three years in relation to teachers experience and qualifications, questionnaires on factors related to teacher quality and classroom observations as well as moderation of learners written tasks.

DURATION OF THE RESEARCH: Three to six months

I appreciate your willingness to participate in the study. I will inform you on the date and the time that I will come for site research at your institution

- For this research you will be interviewed, be provided with a questionnaire, have your lesson observed in a normal setting and have three of your learners written tasks (high, moderate and low)moderated
- Your participation in this study is voluntary, you are not obliged to divulge any information you don't wish to and you may withdraw from the study if you wish to without any fear of penalty.
- I will treat information given to me as confidential. You will not be identified in any document, including interview transcripts and the research report by your surname, first name or by any other information nor will the name of your school be mentioned.
- The research does not involve any risk, however if any discomfort is experienced, every effort will be done to keep it minimal.
- The research finding will be made available to you at you request.
- Should you have any queries about the research, now and the future, you are free to contact me at the numbers given above.
- The will not be any benefits/compensation due to you fir participating in this study.
- I appreciate your willingness to help me complete this study.

I understand the contents of this document and agree to participate in this research.

Signature of participant: _____ Date: 15/01/2013

Name: PHAHLANE SD

GAUTENG DEPT OF EDUCATION
MAMELODI HIGH SCHOOL
P.O. BOX 77013 MAMELODI 0101
2013 -01- 15
TEL: 012 805 7414
FAX: 012 805 8834
E-MAIL: mamelodi@mweb.co.za

APPENDIX H:

Questionnaire for sampled teachers

Sampled teachers profiles

Circle the correct	**Fill in the correct information**					
Gender	Codes					
Female, Male	1		2			
	L4,T2 L2		L1,L2,L3,L5,L6,L7			
Age group						
<35, 35-55, >55	1		2		3	
	L1,T1 &2 L2,		L3,L4,L5,L6,L7			
Professional qualification						
A certificate not related to teaching (0), three years Diploma (1), First Degree/four years diploma (2), Honours degree (3), Master's Degree (4), Doctoral Degree (5)	0	1	2	3	4	5
	L1	T1 L2,L3	T2 L2,5,6	L4,L7		
Additional qualifications						
(ACE,PGCE)	L4					
Highest Qualification in Physical Science/Physical/Chemi						

stry						
None(0), up to first year (2), up to second year (3), up to third years (4), up to four years (5), above four years(6)	1	2	3	4	5	6
	L1			T1 L1,L3L 4,L5,L6	T2 L2, L7	
Type of employment						
Temporary GDE/Independent (1), Permanent GDE (2), SGB (3)	1		2		3	
	L1		T1 &T2 L2,L3,L4,L5,L6,L 7			
Experience in teaching Grade 12 Physical Science						
.	1 = 0-2 years	2 = 3-5 years	3 = 5-10 years	4 =10-20 years	5 = above 20 years	
	L1,T1 L2	L2,L3	L4	L5,L6, L7		
Current Post level						
Level 01 Teacher (1), Senior teacher (2), HOD (3), Deputy Principal (4), Principal (5)	1	2	3	4	5	
	L1,T1&2 L2,L3,L5		L4,L7	L6		

Questionnaire for sampled educators on factors directly related to teaching and their responses

		No	Yes
1	Do you regard qualification key determinants to quality Physical Science results?		L1,L3,L2,L4,L5,L6, L7
2	Do you think that upgrading qualifications(increasing your teacher qualifications in Physical Science teaching can improve the quality of Grade 12 Physical Science results?		L1,L2,L3,L4,L4,L5, L6,L7
3	Has on-going professional development in the form of workshops improved your expertise as a Grade 12 Physical Science educator?	L1,L4,L6	L2,L3,L5,L7
4	As a new educator in the system, were you properly inducted into the system?	L1,L2,L3,L4,L5,L6	L7
5	Do you think that educators who received induction become better Physical Science educator compared to those who were not properly inducted?	L1,L2,L6	L3,L4,L5,L7
6	Do you regard yourself as having sufficient content knowledge to teach Grade 12 in the current curriculum?	L1	L2,L3,L4,L5,L6,L7
7	Have you been offered sufficient Pedagogical Content Knowledge to cope with the changing curriculum at	L1	L2,L3,L4,L5,L6,L7

	tertiary level?		
8	Have you attended workshop that enabled you to cope with the Pedagogical Content Knowledge required for the changing curriculum in the past three years?	L1,L6	L2,L3,L4,L5,L7
9	Do you regard yourself as a competent teacher?		L1,L2,L3,L4,L5,L6, L7
10	Have you produced consistent Grade 12 Physical Science that are above 60% in the past three years	L1,L2,L3,L4,L5	L6,L7
11	Do you think that experience improves the quality of a teacher?		L1,L2,L3,L4,L5,L6, L7

APPENDIX I

CLASSROOM OBSERVATION

		Yes	No	Comment on bringing improvement
PREPARATION OF THE LESSON				
1.1	The teacher arrived to class on time			
1.2	The educator maintains discipline throughout the lesson			
1.3	All resources needed for the lesson are in class within reach(the teacher does not have to leave learners to get them)			
1.4	There is enough evidence that the lesson has been properly prepared for (baseline assessment /introduction, lesson ,assessment)			
LESSON EXECUSSON AND ASSESSMENT				
1.5	The teacher uses the required language of instructions (English) throughout the lesson.			
1.6	The teacher moves about in class during the lesson to attract the attention of all			

	learners			
1.7	The teacher is in control of the lesson (there no weakness obvious to learners)			
1.8	The teacher has enough content knowledge for the topic taught			
1.9	The teaching methodology makes it easy for learners to understand content taught			
1.10	Learners are given sufficient and relevant assessment tasks to understand content taught during the lesson.			
1.11	Practical lessons are given to enhance learning. Do you give these to your learners?			
1.12	Learners are comfortable with the teacher, they are free to ask questions and willingly participate in the lesson.			
1.13	There is follow upon assessment tasks given during the lesson (checking that all learners are engaged in the task, corrections, explanation of answers, clarity on some concepts) to ensure that learners understand content taught.			

HISTORY OF INFORMAL WRITTEN TASKS				
1.14	All examinable content to date has been taught as per progression of the work schedule and assessed in class works, home works and informal tests.			
1.15	The quantity of task and the quality of questions are acceptable to prepare learner for formal tasks.			
1.16	Learners have been exposed to all type of examinable questions (One word questions, multiple choice questions and structured questions assessing all content and skills)			
1.17	There is evidence of control of written tasks and corrections			
HISTORY OF FORMAL WRITTEN TASKS				
1.18	The teacher has an assess program for formal tasks and has given it to learners.			
1.19	Learner have been given formal tasks according to the formal program of assessment			
1.20	All expected examinable content for the term has been			

	assessed in the formal tests.			
1.21	The quantity and the quality of questions are acceptable to prepare learner for the examination.			
1.23	The tests covers all type of examinable questions (One word questions, multiple choice questions and structured questions assessing all content and skills)			
1.24	There is evidence of the teachers' marking, control and corrections of the formal tests.			
1.25	All practical tasks have been completed, marked and moderated internally and by the district moderator.			
TEACHING RESOURCES				
1.26	The teacher is using compliant text books and other resources.			
1.27	All revision resources (past exam question paper with memos , question papers for past formal tests and any other question papers) for work covered so far have been given to learners			

INTERVENTION LESSONS				
1.28	Intervention classes are given to help poor performing learners and improve performance of good performing learners. Have you given these to your learner?			
ANALYSIS OF RESULTS				
1.29	The teacher has the analysis of results for the 2011			
1.30	The teacher has the analysis term 01 and term 02 2012			

Teachers' name: _____ Teachers' signature: _____

Researchers' name: _____ Researchers signature:

_____

Date: _____

School stamp

APPENDIX J

Interview questions with Principals of sampled schools and their responses

1. How long have you been the principal at this school?

Level 01	02 years at this school
Level 02	16 years
Level 03	15 years
Level 04	18 years
Level 05	17 years
Level 06	14years
Level 07	8 years

2. Do all Grade 12 Physical Science teachers have Physical Science /Physics/Chemistry Qualifications?

Level 01	Yes ,my teacher teaches grade 10-12
Level 02	Yes
Level 03	Yes
Level 04	Yes
Level 05	Yes
Level 06	Yes
Level 07	Yes

3. If a particular educator has either Physics or Chemistry qualifications, or not both of them, how do you ensure that the quality of the Physical Science results is not compromised?

Level 01	My teacher has done Mathematics and Science while he was studying Mechanics.
Level 02	N/A
Level 03	N/A
Level 04	N/A
Level 05	N/A
Level 06	N/A
Level 07	N/A

4. Is the Head of department (HOD) for Physical Sciences a qualified Physical Sciences specialist?

Level 01	No, we don't have a Physical Science HOD at my school but my teacher goes to meetings.
Level 02	Yes
Level 03	No
Level 04	No
Level 05	Yes
Level 06	No
Level 07	Yes

5. If the Head of Department for Physical Science is not a Physical Science specialist, how does this affect the management of the subject and in particular the Grade 12 Physical Science results

Level 01	I encourage the teacher to ask for help from other independent school Physical Science teachers
Level 02	N/A
Level 03	I have appointed the teacher as the subject head
Level 04	The teacher is the subject head and they also have support groups
Level 05	N/A
Level 06	The teacher is the only Physical Science teacher and he is also the Deputy Principal but he is very excellent, if he needs help he calls the facilitator
Level 07	N/A

6. Are you happy with the performance of the Physical Sciences HOD and the Grade 12 Physical Sciences teacher?

Level 01	No, but we will improve
Level 02	No
Level 03	No, we need to improve.
Level 04	No, we can do more
Level 05	No, the district wants schools to perform at above 60% and if we do not go above 70% we can easily fall
Level 06	Yes, we are doing well but we aim for more
Level 07	Yes, my teacher is doing well, but there is always room for more

7. Do you consider the values, conduct and behaviour of the Grade 12 Physical Science educators to be of acceptable level? Motivate your answer.

Level 01	Yes	I have not seen any behaviour that I don't like in him
Level 02	Yes	Both my teachers are matured and have good manners
Level 03	Yes	I haven't seen or heard anything wrong about him
Level 04	Yes	She is a very dedicated woman and is very helpful
Level 05	Yes	I can't complain about anything
Level 06	Yes	He is a teacher and a parent to these learners
Level 07	Yes	I only have praises for my teacher

8. How would you describe the attitude of the Grade 12 Physical Science educator towards:

- Their career in general (do they appreciate being educators in this country)
- Other staff members
- The school management
- The learners they teach
- The subject

Responses: Principals were asked to choose between "acceptable" and "unacceptable" and for all questions all principals said the attitude of teachers were acceptable.

9. Do you think that Grade 12 teachers are motivated teachers? Why do you say so?

Responses: Principals were asked to choose between "motivated" and "not motivated" and for all questions all principals said teachers are motivated. Although their answers were not exactly the same they implied that teachers are interested, motivated and hardworking ant that attitude of teachers are acceptable.

10. Do you think that Grade 12 teachers are doing enough to motivate Grade 12 learners to perform well in Physical Science? Why do you say so?

Responses: Principals were asked to choose between “Yes” and “No” and for all questions all principals said teachers are motivated. Although their answers were not exactly the same all reasons that teachers motivate learners to pass Physical Science and offer extra lessons.

11. In your observation about Physical Sciences teachers, are they interested in their work as Physical Science teachers?

Responses: Principals were asked to choose between “Yes” and “No” and for all questions all principals said teachers are interested in the subject. Although their answers were not exactly the same all reasons centred around teachers either being hardworking, attending workshops and offering extra lessons.

12. If not what could be the cause?

N/A

13. Do you think Grade 12 Physical Science teachers are committed to :

- **Producing the best results in Physical Science.**

Responses: Yes to all schools

- **Ensuring that best learners perform to their best and poor performing learners improve their results.**

Responses: Yes to all schools

- **That they upgrade their Physical Science knowledge. What do they do?**

Responses: The level 01 principal and the level 07 principals said that their teachers are furthering their studies, while other principals indicated that teachers attend workshops and meetings

- **That they make every lesson the best they can give. What do they do?**

Responses: Yes to all schools .Thorough preparation and the use of available resources were cited as reasons.

Annexure K

Interview questions before school visits together with teachers' responses

1. How would you describe acceptable values, conduct and behaviour of Physical Science teachers?

Level 01	Good behaviour, friendly always on time
Level 02	Parental role to learners, encourage learners to be scientifically minded. Respect both colleagues and learners
Level 03	Disciplined and well behaved
Level 04	Disciplined, able to work under pressure
Level 05	Good behaviour ,good dress code
Level 06	Committed in his work, always does what he is supposed to do
Level 07	Good conduct, no unacceptable relations with learners, committed

2. What are actions and conduct of educators that can be classified as unprofessional ?

Level 01	Fighting with other colleagues, having affairs with school children, always late
Level 02	Always late, reprimanding learners in a way that they feel bad, quarrelling with colleagues in front of learners
Level 03	Likes fighting with colleagues, bunks classes and absents himself without reason
Level 04	Criticizing colleagues in front of learners. Intimate relations with learners
Level 05	Always late, not prepared for lessons, fights with everyone

Level 06	Too close to learners in an unprofessional way, not committed
Level 07	Too casual about work, non- preparation of lessons, no cooperation with managers

3. Do you think that unprofessional behaviour can affect the performance of a Physical Science teachers and learners .In what way?

Level 01	Yes	Learners stop respecting teachers
Level 02	Yes	Learners are not disciplined and they do not commit to studying
Level 03	Yes	Learners can also disrespect teachers.
Level 04	Yes	Learners will not respect unprofessional teachers and do not take the subject serious
Level 05	Yes	Learners see the teacher as their equal
Level 06	Yes	Learners loose respect of the teacher and do not bother to study his/her subject
Level 07	Yes	Learners tend to think that the teacher does not know the subject and do not trust him, some do not bother to study

4. Do you regard attitude as a factor that can affect learners' performance of Physical Science in Grade12?

Level 01	Yes	The teacher can motivate learners to love the subject
Level 02	No	Performance of learners depends on their commitment and the commitment of the teacher above everything
Level 03	No	Learners can love the subject but not be able to perform in it
Level 04	Yes	The teacher does not compromise to offer extra classes and

		help learners and show interest in their work
Level 05	Yes	Positive attitude to the teacher makes learners to have positive attitude to the subject and then pass the subject
Level 06	Yes	If learners are motivated to learn, they end up having a positive attitude to the subject
Level 07	Yes	If the teacher has a positive attitude to learners and always motivates and encourages learners ,they also develop a positive attitude to the subject

5. How do you describe your attitude and its impact on the Grade 12 Physical Science?

Level 01	I love Physical Science and always tell learners to study hard so that they can have good jobs in the Science field
Level 02	I love the subject and always encourage learners to love it and perform well in it
Level 03	Positive attitude even to the learners who are struggling
Level 04	I always try to make the subject interesting by giving them all sorts of information from internet and sometimes I ask them to do research
Level 05	I do not compromise to give extra lessons, I'm always there for learners
Level 06	I love the subject and want learners to love it the same way so I always motivate them so that they can stay interested
Level 07	I can only sty interested and motivated to teach Physical Science and I love teaching it. I try by all means to make learners love it too.

6. What motivated to take Physical Science teaching a career ?

Level 01	I love Mathematics and Physical Science and even if I'm not a fully qualified teacher, I would like to complete my teaching course in the subject
Level 02	I have love for Maths and Science, understanding the world and how it works
Level 03	I am fascinated by Science and have always wanted to know more
Level 04	I love Physical Science
Level 05	I was always inclined to Mathematics and Physical Science
Level 06	I love teaching Physical Science
Level 07	I love Physical Science

7. Are you still motivated and interested in teaching Physical Science? If you are, what is it that you do that makes you stay motivated? If not what is he causes?

Level 01	Yes and No	Sometimes I am sometimes I am not. These learners are not working hard and it's like you are the only person who should improve results
Level 02	Yes	Continuous learning and the technology that we use nowadays
Level 03	Yes	There are days that I am not sure if I still want to continue teach because if learners are underperforming, everybody thinks it is the teacher
Level 04	Yes	I will stay interested, I live the subject too much
Level 05	Yes	However if another opportunity presents itself in the Science field, I will take it
Level 06	Yes	I have developed connection with the subject and with the

		learners
Level 07	Yes	I regard teaching of Physical Science as my calling

8. How do you motivate learner to stay interested in the subject and to do well in it?

Level 01	I always encourage them
Level 02	Encourage learners to have competition on their performance. The use of electronic lessons. Reward for performance
Level 03	I give learners work to research at the internet
Level 04	I use simulations, practical tasks and the internet
Level 05	Make lessons interesting by doing activities that are interesting
Level 06	Use all available resources, take education trips and allow learners to use their phones to Google information
Level 07	Always strive to make the lesson more interesting and more resent. Do practical tasks where possible and show simulations from the internet to teach difficult topics.

9. Do you regard yourself as committed to:

- Ensuring that each lesson you teach is fruitful, how do you do that in teaching of Physical Science. Motivate your answer.

Level 01	Yes	I prepare for lessons and attend meetings
Level 02	Yes	I prepare thoroughly, I vary teaching methodologies according to the nature of the lesson and assess learners as much as possible

Level 03	Yes	I prepare for lessons and have extra lessons four times a week
Level 04	Yes	Through daily exercises, I can close content gaps and motivate learners to learn
Level 05	Yes	Thorough preparation and effective use of contact time
Level 06	Yes	I prepare thoroughly for lessons and all tests
Level 07	Yes	Effective use of teaching time, give quality assessment activities

- Improving your content and pedagogical content knowledge on the subject. How do you do that?

Level 01	Yes	At the moment I'm studying for a teaching degree with Unisa and I also attend meetings
Level 02	Yes	Always research information because knowledge changes every time
Level 03	Yes	I attend meetings
Level 04	Yes	Continuous research
Level 05	Yes	Going to meeting and researching information at all times.
Level 06	Yes	Continuous attendance to meetings and research
Level 07	Yes	I am the support group leader which means that I hold some meetings. I am also studying a master's degree in the Physical Science teaching field

- Improving the quality of Physical Sciences result at your school. How do you do that?

Level 01	Yes	I give classwork's, homework and tests
Level 02	Yes	Extra lessons ,more assessment tasks, template to record written tasks
Level 03	Yes	Give quality activities, especially past exam question papers
Level 04	Yes	Motivate learners to aim to perform well in order to pursue better careers
Level 05	Yes	Extra lessons ,more assessment tasks, use past exam question papers
Level 06	Yes	Extra lessons ,more assessment tasks, use past exam question papers
Level 07	Yes	Extra lessons ,more assessment tasks, use past exam question papers

10. Did you specialize in Physical Science /Physics/Chemistry teaching Qualifications?

Level 01	I did N6 in Mechanics, I will be studying BED degree and specializing in Natural Sciences
Level 02	Physical Science
Level 03	Chemistry and Physics
Level 04	Physical Science
Level 05	Physical Science
Level 06	Physical Science
Level 07	Physical Science

11. If not, how does that affect your teaching?

Level 01: There are many things that I have to study before teaching; sometimes I think learners can see that I don't know.

12. Does the Head of department (HOD) for Physical Science support you in areas where you need support? How?

Level 01	No	I don't have an HOD.I teach grade 8-12 Natural Sciences and Physical Science
Level 02	Yes	But I get more help from the facilitator because the HOD only teaches in the GET band
Level 03	No	My HOD is not a Physical Science specialist, he is a Mathematics so rely on the facilitator and other Physical Science teachers at support group meetings
Level 04	No	I am the HOD so I rely on my facilitator
Level 05		My HOD is a Life Science specialist but I attend regular Physical Science meetings
Level 06	No	I rely on educators from the support group, our HOD is doing Life Science
Level 07		I am the HOD as well as the support group leader so I depend mostly on my facilitator and other teachers.

13. How do you see yourself contributing to the performance of Physical Science at your school in the next three years? What exactly will you do?

Level 01	Our learners are too weak in the subject, I think if they only accept learners who passed well in Physical Science to do the subject ,we will get results
Level 02	Improve on condition that grade 10 and 11 learners are not condoned to the next grade

Level 03	I want to improve the results to over 60%,continue with extra classes
Level 04	Increase number of learners who pass Physical Sciences and increase the number of those who will go to university entrance.
Level 05	Improve my knowledge of the subject, continue to make learners interested in the subject
Level 06	Continue to encourage learners to do well in the subject and keep with new teaching methods
Level 07	Keep up with current teaching trends, offer more support to learners and continue to develop myself in the subject

APPENDIXES L-1 to I-7

Appendix L-1

Interview questions with the Level 01 teacherr after classroom observations and his responses

Researcher: From the questionnaire you indicated that you have not done teaching qualifications but N6 in Mechanics; don't you see this as a limiting factor to your teaching methodologies and the content level that you have to teach Grade 12?

Participant: The Physics part is not much of a problem because in the N6 course I did there was some Physics although I can see there are new chapters like Doppler effect, Photo electric effect, work, energy theorem which I don't remember doing at school and at the college. For me to teach these topics, I have to study them first.

Researcher: From the evidence of the observation of the topic that you taught today, which happens to be one of the topics that you have mentioned as problematic for you, I could sense a lot of doubt and discomfort as you taught it, in addition to some of the misconceptions that you taught, how will you rectify mistakes done and misconceptions before learners write the June examination?

Participant: I don't know anyone around here, I only came to teach at this school towards the end of February and I don't have an HOD.

Researcher: Have you asked your principal to help you get connected to a school where you can get someone to help you?

Participant: This school is also new mam; it only started last year so I don't think the principal knows many people here?

Researcher: If you would get a buddy teacher – someone who is more experienced in teaching the subject and is producing satisfactory results to help you, would that help improve your performance in class.?

Participant: I think so but also these learners we are having, they are not serious about anything.

Researcher: I have also observed that you have not covered any work on term 01 chemistry work, which constitutes around 40% of Paper 02 final exams. The chemistry topic for term 02 constitutes 50% of the final examination, can you teach Chemistry? How far have you done Chemistry in your qualifications?

Participant: I have only done Chemistry up to Matric, there is no Chemistry in Mechanics N6, but I have registered for BED (specializing in Natural Sciences) with Unisa although I will only start with my studies next year.

Researcher: If that is the case, what will be happening to the examinable part for Chemistry if you keep on avoiding it because that will be part of the exams?

Participant: I will ask some teachers at the meetings to help with the Chemistry in preparation for the exams. I will teach it in this term before the June examinations, but I have to study each topic first before I teach it.

Researcher: What about the SBA tasks, you have only shown me the control test 01 when I asked for formal tasks. You were also supposed to have done the term 01 practical investigation, have you done it or did you forget to give me the task?

Participant: I haven't done any practical activity in any grade 10-12. There is not even 01 apparatus or chemical to do practical's at the school. I have asked the principal to buy required material and have even given him a list of the material that you gave us but I get excuses every time. I don't know what to do.

Researcher: We are in term 02 already which requires you to do practical investigation 02 as well? Do you think you will cope with two practical tasks this term with zero resources and no hope of getting any?

Participant: I don't know at all. I hope the principal will buy at last what I need for these practical activities.

Researcher: Is there no way you can improvise to do these practical activities.

Participant: If I was getting paid enough or even getting my alary every month, I would try. But we haven't been paid for two months to date. The principal says the directors will pay**.**

Researcher: Your classwork's and home wok activities are below acceptable number and the quality is also low, you only assess level 01and 02 questions. Do you think these will be enough for learners to use for revision for the final examination?

Participant: Like I said mam, I came late to the school and I have not taught Chemistry, I also don't know what you mean by level 01 and 02 questions? I use exercises that are in the textbook.

Researcher: The quality of questions need to follow a certain taxonomy called the Blooms taxonomy, look it up in the CAPS document and try to address all questions as well as the types of examinable questions according to the final Grade 12 standard.

Participant: I will, although the documents are in the principal's office right now.

Researcher: The MEC's benchmark for acceptable performance at the end of 2013 is 60%? Is it possible for you to meet this target?

Participant: I don't think so, not while things do not change at my school, maybe in four years' time.

Appendix L-2

Interview questions with the Level 02 teacher after classroom observations and his responses

Researcher: Besides being fully qualified to teach the subject, what other information have you acquired besides content and pedagogical workshops given by the department of education, including me.

Participant: I have gone to Britain four times in four years on a teacher exchange program at my own expense, just to increase the Physical teaching content and modify the teaching methods that I have acquired in this country.

Researcher: I have observed that you use the laptop in your lessons in your teaching and in addition, you also have enough informal assessment tasks. However, I have observed that you do not assess Section A questions in classwork's and Homework's, questions where learners are supposed to define concepts or give explanations, except for 2 to three that you assess in your informal class tests. I have also not seen any question based on practical activities in any of the informal tasks except the standardised test. Don't you think that these could affect the performance of learners in the final examination?

Participant: I try to give more problem solving activities because these are very difficult. The other questions that you mentioned are easy and these learners can pass them by studying them on their own. I have given them past exam question papers.

Researcher: Your school produced has not been able to achieve according to the MECs' benchmark of 60% for the past three years, what could be causing the underperformance with so many current resources at your school and the knowledge and qualifications that you have acquired oversees.

Participant: Last year I was removed from teaching Grade 12 because in 2011 I did not produce good results so those results are not mine; however the2010 and 2011 results are also not good and frustrate me. This year as well, besides all the effort I put into my teaching,60% may be far-fetched, in our school, learner who do

not deserve to be in Grade 12 are presently in Grade 12 because these learners have been condoned to Grade 12,some with very poor results in Physical Sciences because if they fail Mathematics and Physical Science, they change Mathematics to Mathematical Literacy and keep the Physical Sciences and progress with it till Grade 12**.**

Researcher: Is there anything that can be done to help these learners to at least pass Physical Sciences?

Participant: Some who are committed benefit from extra afternoon classes in addition to the Secondary School Improvement Plan (SSIP) programs during Saturdays and school holidays offered by the department, you know mam; a human being can only do so much

Researcher: Does your school have required resource for practical tasks to produce desired results, since I have observed that you have not done informal practical activities to help learners understand the concepts taught?

Participant: We have enough resources and I demonstrate at least one informal practical activity in each topic using e-lessons from the Science videos that I have. We just need a change in systems.

Appendix L-3

Interview questions with the Level 03 teacher after classroom observations and his responses

Researcher: Are you comfortable in teaching Grade 12 Physical Sciences, I am aware that over the years you were allowed to teach Physical sciences only up to grade 11.

Participant: I have always wanted to teach Grade 12 Physical Sciences in Grade 12 because I had produces good grade 10 and 11 results and somehow they were messed up Grade 12 because I wasn't allowed to finish what I started in grade 10.

Researcher: In my classroom observations before and even today, you couple conservative chalkboard and talk teaching with e-lessons including simulations, is this method effective?

Participant: It is, there are learners who understand better when they see things, for example if you speak about movement of molecules; it can only better be understood by learners if you show a simulations. E-lessons also saves a lot of time, you teach more content in a period that talking.

Researcher: I have observed that you do not assess Section A questions in classwork's and Homework's, questions where learners are supposed to define concepts or give explanations, except for 2 to three that you assess in your informal class tests. I have also not seen any question based on practical activities in any of the informal tasks except the standardised test. These questions are at most 50 mark so for each paper. Don't you think that these could affect the performance of learners in the final examination?

Participant: There is not enough time to finish the syllabus so I can't do informal practical investigations**.** With respect to the Section A questions, definitions and explanations, I want to revise them before the June and the trial exams since there only require learners to study.

Researcher: The provincial target for acceptable performance is 60% and above, is this attainable from your school from this year.

Participant: Yes it is, I have all the resources I need, I have extra classes with learners and I comply in as much as I can.

Researcher: But the term 01 results were less than 60%, how possible is that

Participant: These learners did not study enough but hopefully they will learn from their mistakes.

Appendix L-4

Interview questions with the Level 04 teacher after classroom observations and his responses

Researcher: From the questionnaire you indicated that over the teaching Diploma and the Ace qualification that you have, you are studying for an honours degree, what was your major subject in the ACE and what are your majors in the honours degree?

Participant: Education management in both.

Researcher: Do you think that the knowledge you have acquired in both will help you improve your teaching of Physical Sciences?

Participant: I am an HOD and a possible Deputy Principal at my school since I am acting in the position. I do attend any content an methodology workshop that is available for Physical so I think the information from these are sufficient to help me with the subject.

Researcher: At some point during the lesson today, I observed that learners were making noise while you were teaching, some giving naughty answers and you could not control the situation, and don't you think these are some of the things that can affect the performance of your learners?

Participant: I have very naughty learners and you know we should not use corporal punishment so sometimes I don't know what to do.

Researcher: Last year you missed the MECs' benchmark of 60% by 2, 86%, how do you plan to get out of the underperformance status and stay there?

Participant: I have extra classes twice a week for all learners and we are also on target with SBA tasks, so yes I'm coming out, never to return.

Researcher: Do you do other practical activities as you teach sometimes besides formal practical investigations, just to make the lesson understandable and interesting? What about e-lessons?

Participant: We do have a laptop and a data projector that I can use but I don't have sufficient e-knowledge to use them as well as programs for Physical Sciences, however I'm attending E- courses with the Vodacom program for Physical Science teachers. Things will get better next year. You know mam with practical informal tasks, there is no time for that really, and the syllabus is long. I only explain them.

Appendix L-5

Interview questions with the Level 05 teacher after classroom observations and his responses

Researcher: You only have a three year teacher diploma yet you have out shined some schools in the district where some teachers are more qualified than you. How do you do that?

Participant: I make sure that I attend any Physical Science workshop available, use as many resources to prepare for my lessons and I ask for help, when I need it.

Researcher: Is a 100% possible in 2013?

Participant: An improvement to at least 80% is possible because I have some few weak learners that I need to work on. I also have a topic in Mechanics-Work Energy and Power that I need to improve in teaching and assessing. I'm not happy with learner's performance in this topic in term 01 test, but I will re-teach it.

Appendix L-6

Interview questions with the Level 06 teacher after classroom observations and his responses

Researcher: You are the only Physical Science teacher for the FET phase at your school, you do not have a Physical sciences HOD to support you and you are the Deputy Principal, how do you cope with your subject and your management roles, given the fact that your performance is above the set benchmark?

Participant: I plan every time to do everything so that I do not pile up work and end up being incompetent in everything.

Researcher: Between you being a grade 10-12 teachers as well as the deputy principal, do you give extra lessons for the Grade 12 o are you lucky to have clever learners?

Participant: I have one day extra classes per week with the grade 10s',one with the grade 11s'and two with the Grade 12s' every week. I don't necessarily stay with the learners every day especially if I have a management issue to address. I have class leaders that I give extra assessment materials and memoranda for lessons taught, to reinforce what I did in class and the leaders coordinate the corrections for that work. He only time I intervene when the issue cannot be understood. I want my learners to be independent learners and that is my recipe to success.

Researcher: Do you have problems with late submission of SBA tasks?

Participant: I plan for all activities, including which afternoons I will utilize for practical tasks and make learners aware of these days so they are prepared in time. All formal tasks are done at school under my supervision, so I always get my tasks on time.

Researcher: What is the secret to effective lessons?

Participant: I structure my methodologies to the need of the lesson, starting from the old ways of teaching, performing practical activities and showing Science clips

where they are needed. It depends on the nature of my lesson. But most of all I plan for my lessons well as assessment activities for each class.

Appendix L-7

Interview questions with the Level 07 teacher after classroom observations and his responses

Researcher: You have been producing best Physical Sciences results for the past three years and this year you are even the only township school that has been exempted from submitting SBA tasks for external moderation. How do you always get it right?

Participant: I have allowed myself to learn and get every information that can improve my teaching and assessment practices, so I guess that helped a lot. I do not make any assumptions about learners; they are different every year so I treat every group as it is.

Researcher: How are your teaching methods different from other according to your knowledge?

Participant: I teach every examinable content in Grade 12 even though I have taught it in the lower classes, and raise the assessment standard to suit the final Grade 12 exams. I ensure that I cover all types of examinable questions and all levels of questions first in the class-works and home-works, then in the informal test then in the formal, test. I give informal test for all work covered in a week every Friday if we have a full week. In these tests, if any learner gets less than 50% they have to rewrite the test again until they get 60%, so this is a form of revision for them plus they study for the test because they don't want to remain after school to rewrite the tests.

Researcher: Do you have enough resources for yourself and for your learners?

Participant: I have enough resources provided by the school; I also buy some with my own money if I happen to see them at some shop or workshop. I also make sure that my learners have revision material for all work to be covered in a term right at the beginning of each term. I have a question paper bank from school question papers from some teachers that I network with.

Researcher: Your learners seemed free but respect you, they also ask a lot of questions and argue a lot when they disagree. What is the secret to effective lessons?

Participant: Classroom management is the core of an effective lesson. I have set rules that learners are aware of as well as the punishment that goes with not doing the right thing, however I like to use reward more for good behaviour instead of punishment. There is a point system where points are added or deducted for good and bad behaviour. I have also committed to playing more of a parental, pastoral role and a mentor to these learners so that they can want to behave well. I the learners know that you have an interest in their lives as well besides their performance, they never want to let you down.

Researcher: Can I safely say that you will do well this year?

Participant: I'm so scared this year I don't even know what to do. I have thirteen learners who were unlawfully deregistered Physical Sciences in term 01 and have now been registered the subject again term 01 because the school did not comply. These learners started doing Grade 12 Physical Sciences in March, should be ready for the June examination and the trial examination over the fact that they were my weak learners, I now have to make them catch up all term 01 work while I continue teaching term 02 work. I am so overwhelmed at times but I'm not giving up. If I don't get 100% because of this challenge, then at least I'm not getting less than 80%.